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OF THE

KANSAS ACADEMY OF SCIENCE

VOLUME XXVII

CONTAINS

A LIST OF OFFICERS AND PAST PRESIDENTS; MEMBERSHIP LIST JANUARY 1, 1915; MINUTES OF FORTY-SEVENTH ANNUAL MEETING; PRESIDENT'S ADDRESS; SOME PAPERS READ.

DECEMBER 22 AND 23, 1914

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DECEMBER 22 AND 23, 1914

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HISTORICAL SKETCH.

THE organization of a Kansas association of scientific men at an early date was due to the efforts of Rev. Johns D. Parker and Prof. B. F. Mudge, who, in July, 1868, issued a call signed by seventeen men for a meeting of all persons in the state interested in natural sciences to meet in Topeka.

The first meeting was held in September of that year, in Lincoln College (now Washburn), and the Kansas Natural History Society was organized and officers elected. The object, as stated in the original draft of the constitution, "shall be to increase and diffuse a knowledge of the natural sciences, particularly in relation to the state of Kansas." At the fourth annual meeting, held in Leavenworth, in 1871, the name was changed to the Kansas Academy of Science. In 1873 the Academy became a coördinate department of the State Board of Agriculture by the terms of the following act of the legislature:

"The Academy of Science shall be a coördinate department of the State Board of Agriculture, with their office in the agricultural rooms, where they shall place and keep for public inspection the geological, botanical and other specimens, the same to be under the direction and control of the officers of the said Academy of Science. An annual report of the transactions of said Academy of Science shall be made on or before the 15th day of November of each year to the State Board of Agriculture, for publication in the annual transactions of said board."

The Academy has increased in membership from the original small body of scientists to nearly 200. It has held forty-seven annual meetings, of which twenty-two have been held in Topeka, seven in Lawrence, five in Manhattan; two each in Leavenworth, Emporia, Ottawa, Baldwin, and Iola, and one each in Atchison, McPherson, and Wichita.

Twenty-seven volumes of the Transactions have been published, varying in size from a few pages in the early numbers to 350 pages in the later volumes. These publications contain

many papers of recognized scientific value. The exchange list includes over 500 names of societies and libraries.

The museum has been greatly enlarged by the gift of the state mineral display erected at the St. Louis Exposition, and given suitable cases to hold this large amount of material. It thus has the finest economic collection of the Kansas mineral industries in the state—an exhibit which received two gold medals, twenty-two silver medals, and fourteen bronze medals.

This sketch shows that Kansas was early to recognize the importance of science in building up a state, and the Academy has long since justified the expectations of its early founders. It has contributed as a body and through individual members to the discovery and development of our resources. The state coal mines at Leavenworth is an instance of one of the contributions of the late Professor Mudge, one of our Academy's founders. We do not often think of the wonderful mineral resources of Kansas, but our clays and shales, no less than coal, oil and gas, are assets that must be counted. Science must be coupled with toil, and these natural resources will bring no less profit than corn, wheat and alfalfa now furnish. It has come to be seen that farming is applied science, and there is no department of industry in the shop or on the farm where the teaching of the schools fails to bring good returns. The Academy is a bond of union between scientific workers whether in or out of the schools. Such institutions as our Academy are recognized as indispensable in all our progressive states. They fill a place in correlating and binding together our other educational agencies. The leading scientific publications of the world are on our list of exchanges and are constantly increasing the valuable resources of our state library.

CONSTITUTION OF THE ACADEMY.

SECTION 1. This association shall be called the Kansas Academy of Science.

SEC. 2. The objects of this Academy shall be to increase and diffuse knowledge in the various departments of science.

SEC. 3. Members of this Academy shall consist of two classes, active and honorary (including associate). *Active members* may be annual or life members. *Annual members* may be elected at any meeting of the Academy, and shall sign the constitution and pay a fee of one dollar and annual dues of one dollar; but the secretary and treasurer shall be exempt from the payment of dues during the years of their service. Any person who shall at one time contribute twenty dollars to the funds of this Academy may be elected a *life member* of the Academy, free of assessment. Any member who has paid dues to the Academy for ten consecutive years, or who has been legally exempt during any portion of that time, may be elected a *life member* on the payment of ten dollars. Any member who has been a member of this Academy in good standing for twenty years may be elected a *life member* without payment of further fees or dues. *Honorary members* may be elected on account of special prominence in science, on the written recommendation of two members of the Academy. In any case, a two-thirds vote of members present shall elect to membership. Applications for membership in any of the foregoing classes shall be referred to a committee on applications for membership, who shall consider such application and report to the Academy before the election.

SEC. 4. The officers of this Academy shall be chosen by ballot at the annual meeting, and shall consist of a president, two vice presidents, a secretary, and a treasurer, who shall perform the duties usually pertaining to their respective offices. The president, secretary and treasurer shall constitute an executive committee. The secretary shall have charge of all the books, collections and material properly belonging to the Academy.

SEC. 5. Unless otherwise directed by the Academy, the annual meeting shall be held at such time and place as the executive committee shall designate. Other meetings may be called at the discretion of the executive committee.

SEC. 6. This constitution may be altered or amended at any annual meeting, by a vote of three-fourths of attending members of at least one year's standing. No question of amendment shall be decided on the day of its presentation.

BY-LAWS.

I. The first hour, or such part thereof as shall be necessary, in each session, shall be set aside for the transaction of the business of the Academy. The following order of business shall be observed, as far as practicable:

1. Opening.
2. Reports of officers.
3. Reports of standing committees.
4. Appointment of special committees.
5. Unfinished business.
6. New business.
7. Reports of special committees.
8. Election of officers.
9. Election of members.
10. Program.
11. Adjournment.

II. The president shall deliver a public address on the evening of one of the days of the meeting, at the expiration of his term of office.

III. No meeting of this Academy shall be held without a notice of the same having been published in the papers of the state at least thirty days previous.

IV. No bill against the Academy shall be paid by the treasurer without an order signed by the president and secretary.

V. Members who shall allow their dues to remain unpaid for two years, having been annually notified of their arrearage by the treasurer, shall have their names stricken from the roll.

VI. The secretary shall have charge of the distribution, sale and exchange of the published Transactions of the Academy, under such restrictions as may be imposed by the executive committee.

VII. Eight members shall constitute a quorum for the transaction of business.

VIII. The time allotted to the presentation of a single paper shall not exceed fifteen minutes.

IX. No paper shall be entitled to a place on the program unless the manuscript, or an abstract of the same, shall have been previously delivered to the secretary.

PAST PRESIDENTS.

1869, '70....	B. F. Mudge.	1897.....	S. W. Williston.
1871–'73....	John Fraser.	1898.....	D. E. Lantz.
1874–'78....	F. H. Snow.	1899.....	E. B. Knerr.
1879, '80....	B. F. Mudge.	1900.....	A. S. Hitchcock.
1881, '82....	J. T. Lovewell.	1901.....	E. Miller.
1883.....	A. H. Thompson.	1902.....	J. T. Willard.
1884, '85....	R. J. Brown.	1903.....	J. C. Cooper.
1886.....	E. L. Nichols.	1904.....	Edward Bartow.
1887.....	J. D. Parker.	1905.....	L. C. Wooster.
1888.....	J. R. Mead.	1906.....	F. O. Marvin.
1899.....	T. H. Dinsmore, jr.	1907.....	J. A. Yates.
1890.....	G. H. Failyer.	1908.....	E. Haworth.
1891.....	Robert Hay.	1909, '10....	F. B. Dains.
1892.....	E. A. Popenoe.	1911.....	J. M. McWharf.
1893.....	E. H. S. Bailey.	1912.....	F. W. Bushong.
1894.....	L. E. Sayre.	1913.....	A. J. Smith.
1895.....	Warren Knaus.	1914.....	W. A. Harshbarger.
1896.....	D. S. Kelly.	1915.....	J. A. G. Shirk.

OFFICERS OF THE ACADEMY, 1915.

President, J. A. G. SHIRK..... Topeka.
Vice President, J. E. TODD..... Lawrence.
Vice President, F. G. AGRELIUS..... Emporia.
Treasurer, L. D. HAVENHILL..... Lawrence.
Secretary, J. T. LOVEWELL..... Topeka.

EXECUTIVE COUNCIL.

Ex officio the PRESIDENT, TREASURER and SECRETARY.

Elective for 1915.

W. A. HARSHBARGER. L. C. WOOSTER.
J. A. YATES. J. T. WILLARD.

MEMBERSHIP OF THE ACADEMY.

January 1, 1914.

Dates signify date of election to membership in the Academy.

HONORARY MEMBERS.

G. P. Grimsley, Ph. D., 1904, Martinsburg, W. Va.
Edw. L. Nichols, Ph. D., 1897, Cornell Univ., Ithaca, N. Y.
W. S. Franklin, Sc. D., Lehigh Univ., South Bethlehem, Pa.
Geo. Wagner, Ph. D., 1904, Univ. of Wisconsin, Madison, Wis.
S. W. Williston, A. M., M. D., Ph. D., 1902, professor of paleontology, Univ. of Chicago, Chicago, Ill.

ASSOCIATE MEMBER.

Mrs. R. J. Brown, 1903, Leavenworth.

LIFE MEMBERS.

E. H. S. Bailey, Ph. D., 1883, Univ. of Kansas, Lawrence.

Edward Bartow, Ph. D., 1898, director of water survey, Urbana, Ill.

Joshua William Beede, Ph. D., 1894, associate professor of geology, Bloomington, Ind.

F. W. Bushong, Sc. D., 1896, Mellon Institute, Univ. of Pittsburg, Pa.

F. W. Cragin, Ph. D., 1880, economic, geologic and historical research, Colorado Springs, Colo.

Lewis Lindsay Dyche,* M. S., 1881, professor of systematic zoölogy and curator of birds, mammals and fishes, state fish and game warden, Univ. of Kansas, Lawrence.

Geo. H. Failyer, M. Sc., 1879, Manhattan.

E. C. Franklin, Ph. D., 1884, Stanford Univ., Palo Alto, Cal.

I. D. Graham, 1879, Live Stock Com., Panama Ex., San Francisco, Cal.

Wm. Ashbrook Harshbarger, B. S., 1900, professor of mathematics, Washburn Coll., Topeka.

Erasmus Haworth, Ph. D., 1882, state geologist, Univ. of Kansas, Lawrence.

Warren Knaus, M. Sc., 1884, entomologist, editor and publisher, McPherson.

D. E. Lantz, M. Sc., 1887, biological survey, Washington, D. C.

J. T. Lovewell, Ph. D., 1878, chemist, Topeka.

F. O. Marvin, A. M., 1884, Univ. of Kansas, Lawrence.

Ephraim Miller, A. B., A. M., Ph. D., 1873, Pasadena, Cal.

L. E. Sayre, Ph. M., 1885, Univ. of Kansas, Lawrence.

Alva J. Smith, 1903, city engineer, Emporia.

Mrs. L. C. R. Smyth, M. S., Ph. D., 1902, curator of Goss Orinthological Collection, Topeka.

E. G. Smyth, 1901, entomology, Santa Rita, P. R.

C. H. Sternberg, 1896, explorer and collector, Lawrence.

M. L. Ward, D. D., 1880, Ottawa Univ., Ottawa.

J. T. Willard, M. S., 1883, Kansas Agr. Coll., Manhattan.

L. C. Wooster, 1899, Ph. D., professor of geology, Normal School, Emporia.

J. A. Yates, 1897, professor of geology, Normal School, Emporia.

ANNUAL MEMBERS.

Frank G. Agrelius, A. M., 1905, State Normal School, Emporia.

Bennet M. Allen, 1913, professor of zoölogy, Lawrence.

H. C. Allen, 1904, University of Kansas, Lawrence.

Agnes Anderson, 1913, chemist.

John J. Arthur, 1904, Topeka.

Wm. R. Arthur, B. A., 1903, dean of law school, Washburn Coll., Topeka.

Elam Bartholemew, M. S., 1905, mycologist, Stockton.

W. J. Baumgartner, 1904, professor of zoölogy and histology, Univ. of Kansas, Lawrence.

Frank G. Bedell, 1904, Dodge City.

---

*Deceased.

F. H. Billings, Ph. D., 1909, Univ. of Kansas, Lawrence.
H. H. Braucher, 1907, teacher, K. S. N., Emporia.
Frank P. Brock, 1911, Ind. research, Univ. of Kansas, Lawrence.
E. W. Brown, B. S., 1909, Chehalis, Wash.
F. W. Bruckmiller, 1914, chemist state water survey, Lawrence.
L. D. Bushnell, 1909, professor of bacteriology, Agr. Coll., Manhattan.
H. P. Cady, Ph. D., 1904, professor chemistry, Univ. of Kansas, Lawrence.
M. E. Canty, 1903, Fredonia.
I. D. Cardiff, Ph. D., 1909, professor of botany, State Agr. Coll., Pullman, Wash.
V. B. Caris, 1911, professor mathematics, M. T. S., Pittsburg.
W. R. Cleveland, 1914, superintendent of schools, Mulberry.
L. J. Congdon, 1914, assistant food inspector, Board of Health, Topeka.
W. A. Cook, M. S., 1907, Baker Univ., Baldwin.
R. A. Cooley, 1910, Agr. Expt. Station, Bozeman, Mont.
Rev. John T. Copley, 1903, Oak Hill.
Margaret Coventry, 1914, professor of chemistry, Pittsburg.
F. F. Crevecœur, 1899, entomologist, Onaga.
S. J. Crumbine, M. D., 1909, secretary State Board of Health, Topeka.
Frank Burnett Dains, Ph. D., 1902, professor of chemistry, Univ. of Kansas, Lawrence.
B. J. Dalton, C. E., 1909, Univ. of Kansas, Lawrence.
Geo. A. Dean, M. S., 1912, professor of entomology, Manhattan.
O. P. Dellinger, professor of biology, M. T. S., Pittsburg.
S. A. Deel, 1913, professor of physics, Baker Univ., Baldwin.
Emil O. Deere, 1905, Bethany Coll., Lindsborg.
Herman Douthitt, 1914, assistant professor of zoölogy and paleontology, Lawrence.
R. B. Dunlevy, M. A., 1896, S. W. Kansas Coll., Winfield.
J. W. Eby, 1903, banker, Harvard.
C. W. Edmondson, Ph. D., 1909, professor of geology and histology, Eugene, Ore.
H. W. Emerson, B. S., 1904, Univ. of Kansas, Lawrence.
T. L. Eyerly, 1906, high school, department of physiography, Dallas, Tex.
Fred. Faragher, A. B., 1904, with Alden Spear's Sons Co., Chicago, Ill.
A. O. Garrett, 1901, teacher high school, Salt Lake City, Utah.
A. A. Graham, 1910, lawyer, Topeka.
O. S. Groner, Sc. M., 1907, professor of chemistry, Ottawa Univ., Ottawa.
Mary Herman, Ph. D., 1912, Agr. Coll., Manhattan.
H. J. Harnly, B. S., 1903, professor, McPherson Coll., McPherson.
L. D. Havenhill, D. Phar., 1904, professor of pharmaceutical chemistry, Univ. of Kansas, Lawrence.
Thomas J. Headlee, Ph. D., 1907, professor of zoölogy and entomology, Rutgers Coll., New Brunswick, N. J.
D. A. Horton, 1913, entomologist, McPherson.
W. F. Hoyt, A. M., 1902, State Normal School, Neb.
Leroy Hughbanks, 1914, minister and lecturer, Anthony.
I. W. Humphrey, 1912, Mellon Institute, Univ. of Pittsburg, Pa.
Thomas M. Iden, 1897, State Normal School, Emporia.

H. Louis Jackson, B. S., 1909, state food analyst, Univ. of Kansas, Lawrence.
A. W. Jones, 1914, professor of geology, Wesleyan Coll., Salina.
W. H. Keller, 1898, high school, Emporia.
H. H. King, A. B., A. M., 1909, assistant professor of chemistry, Agr. Coll., Manhattan.
Leslie A. Kenoyer, 1906, Toledo, Ia.
Harry L. Kent, 1904, nature study, Agr. Coll., Manhattan.
John H. Klopfer, 1904, collector and mining expert, Topeka.
W. S. Long, 1913, food laboratory chemist, Lawrence.
Marcus A. Low, 1906, attorney C. R. I. & P. railway, Topeka.
L. A. Lowther, 1907, superintendent of schools, Emporia.
J. W. McCulloch, 1911, field agent, Agr. Coll., Manhattan.
David F. McFarland, Ph. D., State Univ., Urbana, Ill.
J. M. McWharf, M. D., 1902, physician, Ottawa.
R. Matthews, D. D. S., 1898, dental surgery, Wichita.
Grace R. Meeker, 1899, botanist, Ottawa.
B. W. Merwin, 1914, field work in archæology, Savonburg.
C. F. Menninger, M. D., 1903, physician, Topeka.
S. T. Millard, M. D., 1909, physician and surgeon, Topeka.
U. G. Mitchell, 1914, associate professor of mathematics, Lawrence.
Robert Mohler, A. B., 1914, teacher, McPherson.
W. L. Moodie, 1906, State Normal, Bellingham, Wash.
Roy L. Moodie, Ph. D., 1909, instructor, Baylor Univ., Dallas, Tex.
Merle M. Moore, 1909, student, Ottawa Univ., Ottawa.
Celia Mulvehill, A. B., 1911, high school, Pittsburg.
R. K. Nabour, 1910, instructor in zoölogy, Agr. Coll., Manhattan.
C. F. Nelson, 1914, associate professor of physiological chemistry, Lawrence.
T. L. Eyerly, 1906, high school, department of physiography, Dallas, Tex.
Fred. Faragher, A. B., 1904, with Alden Spear's Sons Co., Chicago, Ill.
A. O. Garrett, 1901, teacher high school, Salt Lake City, Utah.
Leslie F. Paull, B. S., 1903, Agr. Coll., Fort Collins, Neb.
Rev. P. B. Peabody, 1909, clergyman (ornithologist), Blue Rapids.
L. M. Peace, A. B., 1904, Univ. of Kansas, Lawrence.
Edison Pettit, 1914, assistant in physics, Washburn Coll., Topeka.
L. M. Plairs, asst. entomologist, Agr. Coll., Manhattan.
L. M. Powell, M. D., 1906, physician, Topeka.
Silas Eber Price, D. D., president Ottawa Univ., Ottawa.
Charles Smith Prosser, D. Sec., Ph. D., 1892, educator and geologist, Columbus, Ohio.
Wm. S. Prout, M. D., 1904, Emmet, Kan.
D. L. Randall, Ph. D., 1911, professor of chemistry, Baldwin.
Albert B. Reagan, 1904, director of Indian school, Orr, Minn.
S. L. Redman, 1914, professor of physics, Manual Training Normal, Pittsburg.
L. J. Reiser, 1911, chemist, Topeka.
Geo. E. Rex, 1911, mgr. treating plants, A. T. & S. F. Rly., Topeka.
H. A. Rice, C. E., 1909, assistant professor of engineering, Univ. of Kansas, Lawrence.

J. Risser, 1913, professor of zoölogy, Washburn Coll., Topeka.
Eulalia E. Roseberry, 1909, teacher of physiography, Pittsburg.
J. C. Russell, 1911, professor of agricultural chemistry, Univ. of Minnesota, Minneapolis, Minn.
Frank K. Sanders, D. D., Ph. D., LL. D., 1909, president Washburn Coll., Topeka.
D. C. Schaffner, 1903, Coll. of Emporia, Emporia.
John H. Schaffner, A. M., M. S., 1902, professor of botany, Univ. of Ohio, Columbus, Ohio.
Theo. S. Scheffer, M. S., 1903, Dept. Agriculture, Washington, D. C.
B. W. Scheib, 1914, professor of agriculture, Manual Training Normal, Pittsburg.
M. M. Schmidt, 1914, insurance and student, Home City.
J. W. Scott, Ph. D., Agr. Coll., Manhattan.
M. Sebastian, 1911, Parochial School, Parsons.
Edwin Taylor Shelly, M. D., 1902, physician, Atchison.
Claude J. Shirk, A. M., M. S., 1905, instructor in physics and chemistry, Ottawa.
J. A. G. Shirk, 1904, professor of physics, Pittsburg.
Ralph C. Shuey, 1905, Univ. of Pittsburg, Pa.
S. G. Stewart, M. D., 1904, physician and surgeon, Topeka.
Chas. M. Sterling, A. B., 1904, Univ. of Kansas, Lawrence.
Frank Strong, LL. D., Ph. D., 1905, chancellor of University, Lawrence.
E. F. Stimpson, 1904, Univ. of Kansas, Lawrence.
M. C. Tanquary, Ph. D., 1912, instructor of entomology, Agr. Coll., Manhattan.
E. L. Tague, A. M., professor of chemistry, Washburn Coll., Topeka.
Edgar H. Thomas, 1907, State Normal School, Emporia.
George W. Tidd, 1914, professor of physics, Emporia.
J. E. Todd, A. M., 1907, professor of geology, Univ. of Kansas, Lawrence.
David Train, 1907, Bethany Coll., Lindsborg.
E. S. Tucker, 1904, associate professor of entomology, Dept. Agriculture, Baton Rouge, La.
W. H. Twenhofel, 1910, professor of geology and paleontology, Univ. of Kansas, Lawrence.
Edith M. Twiss, Ph. D., 1910, professor of botany, Washburn Coll., Topeka.
Henry L. Viereck, 1913, entomologist, Lawrence.
P. F. Walker, 1905, Univ. of Kansas, Lawrence.
J. D. Walters, M. S., 1894, Agr. Coll., Manhattan.
Laurance A. Walworth, 1913, taxidermist, Baldwin.
E. C. Warfel, A. M., 1909, lawyer, Topeka.
H. J. Waters, B. Sc., 1909, president Agr. Coll., Manhattan.
E. R. Weidlein, 1911, Univ. of Pittsburg, Pa.
J. E. Welin, A. M., M. S., 1899, professor of chemistry, Bethany Coll., Lindsborg.
Ella Weeks, 1903, Agricultural College, Manhattan.
J. B. Whelan, 1909, professor of chemistry, Univ. of Kansas, Lawrence.
E. A. White, 1909, chemist, Kansas City, Mo.

Stanley D. Wilson, B. A., 1910, instructor in chemistry, Univ. of Chicago, Chicago, Ill.

W. B. Wilson, B. S., M. S., 1903, professor of biology, Ottawa Univ. Ottawa.

C. H. Withington, B. S., 1903, Greeley, Colo.

T. M. Wood, B. S., 1909, instructor, M. T. S., Pittsburg.

H. I. Woods, M. S., 1902, professor physics and astronomy, Washburn Coll., Topeka.

MINUTES OF FORTY-SEVENTH ANNUAL MEETING, KANSAS ACADEMY OF SCIENCE.

TOPEKA, December 22, 1914.

The forty-seventh annual meeting of the Kansas Academy of Science convened at eleven o'clock a. m. in the supreme court room, at the statehouse in Topeka, and was called to order by the president, W. A. Harshbarger.

The secretary's report of the forty-sixth annual meeting, at Baldwin, was accepted as printed in the twenty-sixth volume of the Transactions.

The secretary, in his office as librarian, reported the usual accessions by exchanges, except that from the German states the war had curtailed the number. The Smithsonian and other departments at Washington continue to send us their valuable publications. The bulletins from the Department of Agriculture have been especially frequent and valuable. For the past year we have been unable to get any binding done at the state printing plant, so that now we have more than 500 volumes awaiting binding. A few volumes have been obtained by purchase, and we continue our subscription to the *North American Flora*, of which twenty-five parts have now been issued.

The reports of the secretary-librarian were accepted.

The president named the following committees:

Nominations: Todd, Smith, McWharf.
Resolutions: Kent, Randall, Miss Meeker.
Program: Mrs. Smyth, Agrelius, Reiser.
Necrology: Dains, Willard, Wooster.
Audit: Knaus, Swenson.
Membership: Risser, Warfel, Todd.
Publication: Willard, Bailey, Shirk.
Press: Sayre, Lovewell.
Legislature: Bailey, Knaus, Wooster, Sayre, Yates.

The address of the retiring president being next in order, President Harshbarger gave a very interesting sketch of the past history and future prospects of the Academy. The address is printed in full in this volume.

Following is a list of the papers submitted for this meeting:

1. The Passing of the Orange (second paper). A. A. Graham.
2. Our Changing Seasons. A. A. Graham.

3. The Height of the Clouds Indicative of the Weather. A. A. Graham.
4. Movement of Flocks of Birds and Swarms of Insects. A. A. Graham.
5. Increased Efficiency of Telephonic Communication by Utilization of Its By-products. H. D. Stroud.
6. The Value of Cheap Water Power to Communities and the Modern Way of Procuring It. H. D. Stroud.
7. Coleoptera, *Amblychila*, and *Omus*. W. Knaus.
8. Scarabæidæ, *Plusiotis* and *Strategus*. W. Knaus.
9. Rare Coleoptera in Central Kansas. W. Knaus.
10. Interesting Notes on Captive Reptiles. L. C. R. Smyth.
11. Review of Arnold and Hannibal's "Marine Tertiary Stratigraphy of the North Pacific Coast of North America." A. B. Reagan.
12. Probable Origin of the Rings of Saturn. A. B. Reagan.
13. The Pure-food Law in Kansas. Mrs. Agnes A. Murray.
14. Some Experiments with the Mason Fruit Jar. Mrs. Agnes A. Murray.
15. The Use of Benzidine Hydrochloride in the Determination of Sulphates in Water. F. W. Bruckmiller.
16. Bacteriological Water Analysis Methods as Applied to Western Flora. C. C. Young.
17. A New Form of Petri Dish Cover. C. C. Young.
18. The Search for Potash in Kansas. E. E. Lyder.
19. Heating Values of Natural Gases in the Mid-continental Field. H. C. Allen.
20. A Concise Method for the Classification of Common Food Adulterations. E. H. S. Bailey.
21. The Puget Sound Marine Station. W. J. Baumgartner.
22. The Changes in the Apical Cell in Fern Stems. Relative to the Changes of Mass in the Same. Miss G. M. Charles.
23. The Migration of the Spiny Lobster. Bennet M. Allen.
24. Water Storage in Some of Our Dry Plains Plants. W. C. Stevens.
25. Composition and Properties of the Yucca Plant. C. A. Beath.
26. The Fermentation of Lactose in Milk by *Bacillus coli*. F. H. Billings and Herbert Foote.
27. The Measurement of the Internal Forces of Seeds. Chas. A. Shull.
28. Recent Advance Regarding the Foundations of Mathematics. U. G. Mitchell.
29. The Use of Platinic Chloride as an Alkaloidal Reagent in the Detection and Estimation of Organic Alkaloids and Poisons. George W. Watson.
30. The Analysis of the Chewing Gum of Commerce. Arthur E. Stevenson.
31. Kaw River Lake. J. E. Todd.
32. Cultivation of Medicinal Plants in the United States to Meet the Emergency Caused by European Conflicts. L. E. Sayre.
33. Nutritive Factors in Health and Disease. C. F. Nelson.
34. The Chert Gravels of Eastern Kansas. L. C. Wooster.
35. Corn Oil. L. E. Sayre.

35*a*. Chemical Analysis of Two Plants, Muscale Buttons and *Prunella vulgaris* (Reputed as an Antidote for Ivy Poisoning). L. E. Sayre.

36. Wood staining by fuming. J. A. Yates.
37. A Study of the Gelatinizing Agents, Pasty Materials, and Thickeners Used in Food Products. Leon A. Congdon.
38. The Loss of Nitrogen and Organic Matter in Cultivated Kansas Soils and the Effect of this Loss on the Crop-producing Power of the Soil. C. O. Swanson.
39. Kaw Valley Anticline. E. C. Warfel.
40. A Deep Well at Elmdale. A. J. Smith.
41. Municipal Illumination. J. A. G. Shirk.
42. America's Opportunity in Science. S. W. Tidd.
43. Malignant Tumors. J. W. McWharf.
44. Echinacea. Grace Meeker.

From this list the Program Committee selected No. 15, "The Use of Benzidine Hydrochloride in the Determination of Sulphates in Water," as the first to be read.

There was no discussion of the paper, and No. 18, "Search for Potash in Kansas," was the next paper posted, which was read by the author, E. E. Lyder.

Professor Sayre remarked on the old way of obtaining potash by lixiviating the ashes of wood or of corncobs and then using the lye to make soap, and by evaporating the lye in kettles or pots they obtained the dry product, or potash of commerce.

Professor Wooster thought the potash in Kansas soils was derived ultimately from the decomposition of granite from the Wichita and Ozark mountains.

Professor Twenhofel said that marine fossils are found in Kansas soils which are known to contain potash, but he regards it very uncertain how potash deposits were made in Kansas.

Professor Wooster asked if analyses had been made from the salt water from deep wells. Mr. Lyder said he had tested for bromine and iodine and one or two samples for potash, but he found only a very little.

Professor Bruckmiller said that in a well 2000 feet deep, in Denison, Tex., 226 parts per million of potash had been found, which was regarded as quite encouraging.

The next paper was No. 38, on "The Loss of Nitrogen and Organic Matter in Cultivated Kansas Soils and the Effect of this Loss on the Crop-producing Power of the Soil," by C. O. Swanson.

Professor Swanson remarked that Kansas soils are unusually rich in potassium, the average being about two per

cent, but it requires organic matter to make this potassium available in crop production.

Miss Meeker inquired about the value of fallen leaves, and asked if they would introduce too much of acid elements.

Professor Swanson thought the lime in the soil will sufficiently neutralize the acids, and it was a good plan to save the fallen leaves and organic matter from stables and apply to the soil. Professor Swanson called attention to the government activities in getting potash from the kelp on our Pacific coast to secure the supplies of potassium needed in our fertilizers and other industries. Some things that do not enter into the constitution of plants are yet essential to their growth, *e. g.*, lime.

Professor Risser said that while sugar does not contain potash, yet the soil in which beets grow must contain it to make a good growth.

Professor Bailey remarked that the substances added to soils to improve their fertility must be in a soluble form. Now feldspar contains potassium, but is insoluble, and must be broken down before it is available. There are certain organic acids—humic acid and compounds of that class—in the soil which with manure from animals hasten the chemical action which breaks down the insoluble compounds.

Professor Swanson said that peat was old organic matter which decays very slowly, and is much more available when mixed with manure when it is added to worn soils.

Professor Twenhofel said that on the northern shores of Russia they have long used the sea weed, washed up on shore by the winds, as a fertilizer. The farmers spread it, finely broken up, on their fields. In the blue-grass region of Kentucky, famed for its fertility, it takes forty feet of limestone to produce one foot of soil, and required 4500 years to produce the soil of the blue-grass region. This demonstrates the immense value of the soil—the production of millions of years. One other point in soil fertility is the need of moisture. In some of the arid regions they can never get a crop. By storing the water a large per cent of these arid regions can be brought to fertility.

Professor Sayre spoke of a farm in Michigan with very deep black muck soil. The proprietor said he used a fertilizer rich in potash and continued to get good crops of peppermint, which he was cultivating.

Professor Swanson said that peat soils are low in potassium, and if cultivated to corn after a year or two would get stalks but no ears, but if you supply potassium the corn will produce ears.

President Harshbarger said that his hobby was roses, and that he raked up all the leaves he could get on his own and on his neighbors' lawns and piled them up till decomposed and then raked the leaves back on the roses; only he had to be careful not to get the soil too light for roses. The black gumbo soil we have is rich enough in potash. I need a fine light loam.

Professor Swanson said the average Kansas soil contains almost 2 per cent of potassium, while some of the commercial fertilizers do not contain more than 1.66 per cent of potassium.

Professor Wooster said that as peppermint oil is made of carbon dioxide, water and sunshine, so the growing of peppermint does not impair the soil, provided the balance of the plant is returned to the soil.

Professor Sayre said we are apt to be misled by conclusions of that sort, for while the statement is correct so far as the oil is concerned, the thing which produces the skeleton which holds the material for the liberation of the oil requires potash, as stated by the agriculturists.

Professor Twenhofel asked whether there are not some things in the soil which do not enter into the plant at all and may yet aid its growth.

Professor Swanson answered yes; the plant does not use any soil carbon, yet the soil carbon is half of the organic matter of the soil, and is one of its most beneficial constituents. So all plants need for their tissues a comparatively small amount of lime, but the soil must have a great deal of lime in order to have proper conditions for plant growth. The soil must furnish the essential elements of a plant or it will not bear a fertile seed—will not make a life cycle. If calcium, phosphorus, potassium or iron is absent the plant will not make a life cycle.

Professor Risser said that beets grown in soil with low potash content have 14 per cent of sugar, while if the soil had a high potash content the beets would contain up to 20 per cent of sugar, which shows that potash is a very essential element in making the beet.

The president remarked that in putting up a building we need scaffolding; so in plant growth the potash may perform this office.

The next paper read was No. 33, "Nutritive Factors in Health and Disease," by C. F. Nelson.

Professor Bailey inquired if the investigation carried on would indicate that life would be sustained and the animal grow through aminic acid.

Professor Nelson replied that this had been done very conclusively in this case, and there are cases recorded where man has been kept neither losing nor gaining in weight for about a week.

The next paper called for was No. 23, "The Migration of the Spiny Lobster," by B. M. Allen.

Mrs. Smyth asked if the migration is affected by the current.

Professor Allen said those that went farthest went with the current, and in general along the shore the currents come that way. The water was ten to twelve fathoms deep. They travel almost wholly by walking. In one or two cases lobsters scrambled along on the surface of the water by a quick motion of the tail.

Professor Risser said there were some experiments carried on at Woods Hole laboratory which showed that the migration was in any direction, but the lobster is a rather contented individual and does not carry about very much, and does not care to worry himself, so to speak. The distance traveled as indicated by Professor Allen's paper may be but a small part of the distance the animal may have wandered back and forth in all this time, and not at any time taken any considerable trip. He may travel a great many miles more than those tags would indicate. With reference to their going into traps, we know that the traps are baited with the food he likes best and that his natural ability for getting food is small, for scarcely would he come to your trap again if he could get food elsewhere. I will say that the fishermen were very good, indeed, and I doubt if the original fishermen would have done more.

Professor Allen remarked that the Japanese and other fishermen were willing to furnish fine marketable lobsters which would bring two or three dollars in the market, without any

return at all. In reply to a question by Professor Wooster, Professor Allen remarked that sex or age of the lobsters made no difference, so far as the records show.

The next paper, No. 32, "The Cultivation of Medicinal Plants in the United States," was read by its author, Dr. L. E. Sayre.

Miss Meeker inquired about the value of these plants. She had a friend who had been growing ginseng for a number of years, and in consequence of the war he was offered only a dollar a pound for the root, and I wondered what he usually got.

Professor Sayre did not know the market quotations, and did not think that America was the best market for it. If a plant has a commercial value there must be something to support it. So far as ginseng is concerned, it has practically no value in medicine here in the United States. In China they pay large sums for it and there is a great demand. The plant has not been very well investigated in this country, because physicians have not a method of treatment with it. In growing it you can succeed better in cuttings than from seed.

Miss Meeker said that her friend puts the seed in the ground for a certain time and lets it stay, but it takes two years to bring it to the point of germination.

The treasurer's report was read, as follows:

RECEIPTS.

Balance from 1913	$900.62	
Dues	68.00	
Interest	33.19	
Sale of Transactions	5.24	
Total		$1,007.05

DISBURSEMENTS.

Stenographer	$6.13	
Expenses of Executive Committee	1.48	
Total		$7.61
Balance on hand		$999.44

The auditors reported the account correct and approved it. On motion, the treasurer's report was adopted.

The next paper taken up was No. 34, "The Chert Gravels of Eastern Kansas," by L. C. Wooster.

The president called for questions or remarks.

Professor Todd said he did not understand the chert gravels to be a sign of the primary extension of the Benton from any particular point. Professor Wooster replied that the chert

gravels should be the measure of the form and extension of the Permian.

Professor Todd remarked that he had a paper for to-morrow about chert. There is chert in the vicinity of Lawrence, and we have a line of it following the hills, 125 to 150 feet above the present course of the Kansas river, with lines of gravels. St. Marys and west of Wamego there are specific surfaces that are covered with chert lying 125 to 150 feet above the present stream.

Professor Yates said it seemed as though there were ledges of this gravel. I recall a quite prominent ledge of the gravel at Ottawa, probably five feet above the Mesozoic. Now this interval in the valley of the Mesozoic is analogous to the valley of the Cottonwood that is spoken of, and also the stream at Eureka.

The next paper read was No. 29, on "The Use of Platinic Chloride in Estimating Organic Alkaloids," by G. W. Watson.

Professor Bailey inquired what would be the effect supposing other alkaloids were present, as, for example, morphine.

Professor Watson replied that their difference in solubility would distinguish them.

The Academy next listened to a very interesting and instructive lecture by Dr. E. L. Nichols, head professor of physics in Cornell University; subject, "Artificial Daylight."

The members of the Academy then repaired to the Y. W. C. A. building, where an excellent banquet was served, which was followed by pleasant speeches by Doctor Nichols and others.

WEDNESDAY, DECEMBER 23.

The Academy resumed its sessions at the supreme court room, and reports of committees were called for.

The Committee on Membership reported the following names of persons applying for annual membership:

F. W. Bruckmiller, chemist state water survey, Lawrence.

W. R. Cleveland, superintendent of schools, Mulberry.

L. J. Congdon, assistant food inspector, Board of Health, Topeka.

Margaret Coventry, professor of chemistry, Manual Training Normal, Pittsburg.

Herman Douthitt, assistant professor of zoölogy and paleontology, University of Kansas, Lawrence.

Leroy Hughbanks, minister and lecturer, Anthony.

A. W. Jones, professor of geology, Wesleyan College, Salina.

U. G. Mitchell, associate professor of mathematics, University of Kansas, Lawrence.

B. W. Merwin, field work in archæology, Savonburg.

Robert Mohler, A. B., teacher, McPherson.

C. F. Nelson, associate professor of physiological chemistry, Lawrence.

Edison Pettit, assistant in physics, Washburn College, Topeka.

S. L. Redman, professor of physics, Manual Training Normal, Pittsburg.

B. W. Scheib, professor of agriculture, Manual Training Normal, Pittsburg.

M. M. Schmidt, insurance and student, Home City.

George W. Tidd, professor of physics, Normal School, Emporia.

The following are recommended for life membership:

L. C. Wooster, Ph. D., professor of geology, Normal School, Emporia.

J. A. Yates, professor of geology and physics, Manual Training Normal, Pittsburg.

On motion, the rules were suspended and the secretary cast the ballot, and the persons above named were declared duly elected.

Prof. J. A. Yates presented paper No. 36, "Wood Staining by Fuming." It was illustrated by many specimens of his work and received hearty applause. Professor Yates said it was claimed that catalpa wood would not season; that one person had kept it in his shop for six months, and while it was seasoned on the outside, the inside was perfectly green.

In discussing this question several members thought there must be mistake in the facts as reported.

Papers Nos. 7, 8 and 9 were next taken up by Mr. Knaus, their author, who exhibited specimens of rare Coleoptera. Some of these you never see during daylight, and it is only by chance that the collector can find them feeding early in the morning. The genus *Omus* is found exclusively in the region west of the Sierra Nevada mountains, and there is no record of any having been taken in the East. It is exceedingly difficult to add these species to one's collection, for only two or three parties collect them in California. The collection here exhibited is probably the third or fourth best collection in this country.

The next paper, No. 43, "Malignant Tumors," was read by its author, Doctor McWharf.

Professor Yates asked if this disease could be communicated easily.

Doctor McWharf replied, "I did not say easily; I said it

could be communicated." There are a number of cases on record of nurses who devoted most of their time to the care of cancer patients, and almost all of these nurses have cancer.

Professor Wooster said he was interested and somewhat surprised at Doctor McWharf's statement last year of the mortality due to cancer, and wanted to know his present idea on this point.

Doctor McWharf: "We have not improved that any."

Professor Bailey said it seemed to him rather remarkable that sulphates should be accused of having anything to do with this disease, especially as we know that sulphates are so important in killing these lower organisms. We could find some place where coal is not used, and so could not get sulphates. If in this place the excess of cancer was not found, the contention would be proven.

Professor Wooster said that while sulphates have a tendency along this line, is it not possible that they may weaken the resisting power of the cells to the inroads of the parasite?

A member remarked that the conclusion is that we at present knew nothing about the origin of cancer, and that this Academy should coöperate with those who make it a serious study. Most of the advertised cures are brought out by ignorant quacks.

The next paper was No. 41, "Municipal Illumination," by J. A. G. Shirk.

Professor Yates asked what was the length of the blocks where this system was installed. The answer was 300 feet. The system was overhead because the street-car company wanted to use the same, and the expense of poles was paid for by abutting property owners. The street-car company and the electric-light company provide the light.

Miss Meeker asked how this could be municipal illumination, since the street-car company is a corporation. It was answered that the city does not own the electric-light plant; it is a private plant.

Professor Yates said that in the last six or eight years no greater improvement had been made in any city than in the lighting system. In our city of 3700 people we installed our present system about four years ago. On each side of the street or block we have eight poles to the block, and we have two lights to the pole. We cut out the old waterworks main,

which was in the center of the street, and laid it on one side, just below the cable of the electric light where both can be reached in a few minutes without tearing up the pavement. We are using the mazda light, and will soon have them changed to the tungsten. I have never heard any one complain about this civic improvement.

The next paper, No. 44, was by Miss Meeker, subject, "Echinacea," or "Braunesia."

Miss Meeker said: "Sometime about February 15 Doctor Sayre asked me if I would send cuttings or seeds of the plant listed as *Echinacea*, and immediately I went out to a quarry close to the city limits and found it, but it was not easy to dig, and I did not get very satisfactory roots. The plants of a number of last season's growth had branches, and the seeds were just ready to drop, and the next day I sent the gentleman the plant and a package of seeds and the roots. When Doctor Sayre presented it to the Academy I remembered we did not have that species at all where I grew up: that it is a western plant, and I should have gone back for more of it, determined the species and written a paper about it as suggested by Doctor Sayre. The seed shatters out in the fall and comes up in the spring, or waits a year. Mr. Bartholomew says that the plant grows in the medical botanical gardens in Washington and has an understood commercial value. Doctor McWharf brought me a book which stated that the western Kansas people invariably called it 'nigger-head.' My aunt, who is a botanist, called it 'hedge-hog flower.' It is also called 'the Kansas daisy,' 'black Sampson.' It is used sucessfully as an antidote to rattlesnake poison."

Prof. J. E. Todd's paper, No. 31, "The Kaw River Lake," was next taken up. Professor Todd announced that his paper was as yet incomplete, but from a large map on the wall he illustrated how the lake is located, and he referred to our late honored member, Prof. B. B. Smythe, whose papers first drew his attention to this subject. This old glacial lake has scattered boulders at least as far north as Manhattan, as reported by Mr. Robert Hay, and they are from 125 to 150 feet above the present level of the Kansas river. The layers of chert, gravel, boulders and silt are particularly well shown in a channel which extends from the northeastern part of Manhattan northward and comes out crossing the lake and Blue some two or three miles north of Manhattan.

Now, this valley is a good sample of the valley of the Kansas river preceding the coming of the ice, as is recorded by the deposits of chert and gravel near the bottom of the channel, and the streams of ice frequently deposited granite boulders in Louis Lake, and silt some thirty feet in depth, so that we have the relation of the boulders, silts and sand, showing the marks of the old channel, and from the divide between Kansas river and Mill creek just southwest of the edge of the ice sheet, which is marked by granite boulders as large as haystacks to the southwest of this edge of ice.

These boulders were covered with a layer of silt fifteen or twenty feet in thickness, so that we have every evidence of a rapid stream when the boulders were deposited. There is no evidence of any boulder having been on the south of Manhattan. There is a valley, which is now occupied by the railroad from McFarland to Alma, fifty or sixty feet lower than the former valley. This valley shows no boulders except in the southwestern portion, where we may see it is so related that the boulders may have worked back into this tributary side channel. The chert gravels mark a deposit of the preglacial Kansas river, and show its course passing through here north of Manhattan. There are no boulders south of Manhattan, but in Reservoir Hill, north, they are abundant. The tracings of the preglacial river are found near St. Marys, north of Topeka, and were distinctly traced along to the northeast of Lawrence. Into this valley came the ice bed of the Kansas streams, filling the valley from Wamego to Lecompton, passing all the drainage around the edge of the ice sheet and then into this lake. As the ice receded, the first effect would be to swell the stream and carry its sediment along this channel, and perhaps fill it up, and when the ice receded the stream would revert to its original channel, and perhaps largely drain the lake, whose bottom would be no lower down than the level of the preglacial channel. As the ice receded there may have been a cutting down of the channel to its original depth or deeper, as may be observed in the deep deposits of sand north of St. George. Since the Glacial Period the river bed here has been cut down 250 to 300 feet below the preglacial channel, so that if there were any boulders here they would all have been carried to the lower depths of the Kaw.

Professor Todd asks for more time to continue his investigations before presenting his revised paper to the Academy for publication.

The next paper, No. 20, was by Prof. E. H. S. Bailey, "A Concise Method for the Classification of Common Food Adulterations." This paper was listened to with much interest, but there was no discussion.

The next paper, No. 39, "The Kaw Valley Anticline," was read by its author, Mr. E. C. Warfel. Specimens were exhibited of a substance like granite which was struck at the depth of 1000 feet in each of two holes which were drilled about half a mile apart, and some petroleum which came from a well bored north of Wamego.

On motion, Mr. Alva Smith's paper was called for before any discussion of Mr. Warfel's paper, since the subjects were kindred.

Mr. Smith then read his paper, No. 40, "A Deep Well at Elmdale." He said his attention was called to gas development at Elmdale about thirty years ago, when a well was dug there which at thirty feet deep had such a flow of gas that they could not use the water and abandoned the well. An old lady and gentleman, owners of the well, would not allow anything to be done with it, and the gas continued to bubble through the water for a number of years. Finally they drilled at Elmdale about five years ago and struck gas at depths of from 40 to 500 feet, three or four different sands producing it. We are on a line with the gas at Newkirk, Okla., and it ought to space within ten or twelve miles of this gas. For instance, we have El Dorado, within two miles of the line; then we pass further up within five or ten miles from Burns, and then within a mile over to Elmdale, and within five or six miles of Wilsey, where five years ago they found gas at a depth of 500 feet, and the line passes within a mile of the well at Dwight.

Professor Wooster said, in reference to the so-named granite struck in the borings near Zeandale, that the materials composing this rock may have been washed there by the various streams of water, and then in presence of a saline solution there was a process of cementation, and a stone resembling granite may have been formed from the sandstone, as I have noticed in my work in Wisconsin, where there was sandstone. In the specimen exhibited there is only 16 per cent of feldspar, which in the real granite exceeds all the other mineral constituents.

Therefore, I judge, this stone is merely a local cementation of sandstone. There are two theories as to the origin of oil and natural gas. In the case of organic matter and gas that comes from the interior of the earth, wherever there is a deep enough fissure, when the gas reaches a higher level it combines with the organic matter, giving us our oils and gas. Under the Arkansas river in Oklahoma there is a downfall of two miles nearly in the strata, opening down to an unknown depth, and we pump gas and oil from the depths of the interior of the earth, which is according to the second theory mentioned. Now in the anticline this gas is natural, and exactly in line with the map in the same general anticline that comes up from Oklahoma, and so our gas and oil are not derived from the interior of the earth below Kansas, but all comes from the south.

The next paper, No. 37, "A Study of the Gelatinizing Agents and Thickeners Used in Food Products," by L. A. Congdon, was read and discussed. A member asked if there is any reason for the preference which some have for cane sugar in making jellies.

Mr. Congdon answered that chemically there is no difference between cane and beet sugar.

The Academy adjourned to the Y. W. C. A. building, where a generous banquet had been prepared. At the close of the banquet Doctor Nichols made some remarks in which he spoke very feelingly of his former residence in Kansas and his connection with the Academy.

Returning to the supreme court room the report of the Committee on Nominations was called for, and the chairman reported the following nominations:

President, J. A. G. Shirk, Pittsburg.

First vice president, J. E. Todd, Lawrence.

Second vice president, F. G. Agrelius, Emporia.

Treasurer, L. D. Havenhill, Lawrence.

Secretary, J. T. Lovewell, Topeka.

On motion the rules were suspended, and the report was adopted. President Harshbarger cast the ballot, and the above-named officers were declared duly elected for the ensuing year.

The committee also reported the following nominations for elective members of the Executive Council, who likewise, on suspension of the rules, were declared duly elected:

Members of the Executive Council: W. A. Harshbarger, J. A. Yates, L. C. Wooster, J. T. Willard.

Professor Twenhofel made a short talk on the subject of his paper, with the expectation of having a more complete discussion at a future meeting.

It was voted that other papers on the program and not read be referred to the Publication Committee.

No further business being reported, the forty-seventh annual meeting was adjourned *sine die*.

ADDRESS OF THE RETIRING PRESIDENT.

W. A. Harshbarger, Professor of Mathematics, Washburn College.

ON this, the forty-seventh anniversary of the Kansas Academy of Science, we stand on that ever-advancing line called the present, and eagerly look forward into that unknown realm called the future, where lies all that we wish to accomplish. In the immediate foreground we can clearly see things that we wish to accomplish—changes in our environment that will benefit us as an organization and lead to larger future usefulness to the state. In planning our future policy we may gain inspiration and breadth of view by a brief review of the past, or, so to speak, taking a hasty inventory. In this review it is neither possible nor desirable to enter into details. This has been done by Doctor Thompson, Professor Wooster and others, and is recorded in our Transactions. We shall note briefly the beginnings of the Society, with the beginnings and progress of some lines of investigation that have been carried through a series of years to logical completion, or are still in progress.

The conception and organization of the Kansas Academy of Science, or the Kansas Natural History Society, as it was named until the fourth annual meeting, 1871, has been fully treated in the address of the retiring president, Dr. A. H. Thompson, October 21, 1883. It is my purpose to relate very briefly the main points in the organization, and pass at once to the work accomplished by the Society.

In 1867 Prof. J. D. Parker was called to Lincoln College (now Washburn). Observing that there was no scientific association in the state, and that the scientists then at work had no organization to centralize their work and no uniform method of publication, he at once began to agitate the matter of forming such an organization, but received no encouragement. People were busy with other things, and science received but little attention. Finally he wrote to Professor Mudge, who was heartily in favor of such a society, but feared the time was not ripe, giving as one of his reasons that Professor Winchell had made a similar attempt in Michigan and had failed. Professor Parker visited Professor Mudge during

the long vacation of 1867, and after thorough discussion of the matter secured Professor Mudge's promise to go into the movement. Several articles were then published urging the importance of such an organization, and in the *Journal of Education* for March, 1868, Professor Parker published the following notice:

"We, the undersigned, desirous of securing the advantages arising from the association in scientific pursuits, and of giving a more systematic direction to scientific research in our state, do hereby invite all persons in the state interested in natural science to meet at Topeka on the first Tuesday of September next, at three p. m., at the College building, for the purpose of organizing a State Natural History Society."

This call was signed by the following seventeen persons: John Fraser, D. H. Robinson, B. F. Mudge, J. A. Banfield, J. S. Hougham, J. D. Parker, R. A. Barker, D. Brockway, G. E. Chapin, J. H. Carruth, R. D. Parker, Jeff. Robinson, Peter McVicar, F. H. Snow, J. S. Whitman, Richard Cordley, J. R. Swallow. The meeting was held at the appointed time, with a very small attendance, and the organization effected. The name chosen, Kansas Natural History Society, was adopted from the Illinois Natural History Society, of which Professor Parker had been a member. The following officers were elected: President, B. F. Mudge; vice president, J. S. Whitman; secretary, J. D. Parker; treasurer, F. H. Snow; curator, J. A. Banfield. No papers were read at this meeting.

The second meeting was held at Topeka September 7, 1869, with a very small attendance. The following papers were read: "On the Internal Heat of the Earth," by B. F. Mudge; "On Solving the Higher Equations," by Edward Cove. A public lecture on "The Moundbuilders" was given by J. D. Parker. The officers of the previous year were reëlected. The attendance at this meeting was so small and the state of the treasury so unsatisfactory that a general feeling of gloom and doubt as to the existence of the Society was very evident. Here, as on so many other occasions, the energy and optimism of Professor Mudge came to the rescue. He urged the members not to despise the day of small things, and to never say fail until they had really failed. The Society was unanimously invited by the three professors of the State University to hold the next meeting in Lawrence, and the invitation was gladly accepted.

The third meeting was held in the University building at

Lawrence, September 5 and 6, 1870. This meeting proved to be the turning point in the life of the Society. The following papers were read:

On the Plants of Kansas. J. H. Carruth.

On the Fishes of the Kansas River as Observed at Lawrence. F. H. Snow.

On the Internal Heat of the Earth. J. D. Parker.

On the comparison of the Coals of Kansas with Other Western Coals. W. H. Saunders.

On the Saurian Formation of Kansas. B. F. Mudge.

On the Moss Agate Formation of Kansas. B. F. Mudge.

The following public lectures were delivered:

On Aims, Organization and Advantage of Scientific Association. John Fraser.

On Hugh Miller, or the Workingman's Education. J. H. Burrows.

At this meeting resolutions were presented urging the enlargement of the scope of the Society so as to include every line of scientific exploration and investigation, and to change its name to the Kansas Academy of Science. These resolutions were adopted at the fourth annual meeting, held at Leavenworth, October 25 and 26, 1871. Beginning with the third meeting, the progress of the Society was rapid, as is shown by the number of papers read, and their character.

At the meeting of the legislature in 1873 the Academy was made a coördinate branch of the State Board of Agriculture, and given permission to have its proceedings published by the state printer, and also given quarters in the Capitol building. This unsolicited act was a well-merited recognition of the work the Academy was undertaking.

Thus far I have followed the reports of the Society literally in an endeavor to show the meager beginnings, the difficulties and discouragements of the organization. The development of the state has been so rapid that it is very difficult to appreciate the conditions forty-seven years ago. The War of the Rebellion was just over. The effects of the border strife were still shown in the rifle pits along the south side of the town and the palisades still standing at Kansas avenue and Sixth street. The Union Pacific railway had reached Topeka only two years earlier, and the construction of the Atchison, Topeka & Santa Fe railway was begun that year (1868). The Indians were still on the rampage in much of the state, making travel at times exceedingly hazardous. The famous battle of the

Arickaree was fought in the same month in which the Society was organized, and Sheridan's winter campaign, in which the Nineteenth Kansas participated, and which broke the strength of the Plains tribes, occurred the following winter. Small wonder that the advance of scientific investigation was slow and that people expressed small interest in such work. The people generally were fully occupied earning the necessities of life. So we find a very small band of investigators on the 82,000 square miles that was the foundation of a great state yet to be, but not yet arrived. This area was covered with a vegetation largely unknown, an unknown population of birds, mammals, fishes, reptiles and insects, while the mineral resources were but a guess. Clearly the first work needed was an inventory, and it was along this line that the members proceeded. It is true that some work had been done, but the condition of the scientific knowledge of the state is vividly portrayed in an article in the *Journal of Education* a little previous to this time, in which the importance of a geological survey was urged. This article advanced the argument that if such a survey only succeeded in discovering coal and salt it would richly repay the cost.

With this hasty view of the condition of the state at the time of the organization of the Academy it is my purpose to show from the Transactions how the Academy has made definite contributions to the much-needed scientific knowledge. I find myself embarrassed with a wealth of material. It will be impossible to do justice to the individual workers. I can only mention the names of those most prominent in the few lines I shall here record.

From the beginning of its existence, probably the most cherished ambition of the Academy was the securing of an adequate geological survey of the state. The mineral resources were practically unknown, and much money was being wasted in ventures that with fuller knowledge would have been successful, or else would not have been attempted. Hardly a meeting passed without some discussion of this topic. At the seventh meeting Professor Mudge read a very earnest paper on the importance of a geological survey of the state. At the eighth meeting a committee was appointed to draft resolutions urging such a survey, and at the ninth meeting these resolutions were adopted. At the sixteenth meeting, in the address

of the retiring president, Doctor Thompson spoke very earnestly in favor of such a survey. At the seventeenth meeting Dr. R. J. Brown chose for the subject of the president's address, "Is a Geological Survey of the State a Necessity?" Doctor Brown corresponded with officials in each state where such a survey had been made or was in progress, and thus accumulated a formidable array of evidence in favor of such a survey. Without going further into details, it is sufficient to say that after many years of urging and educational work on the part of the Academy an adequate geological survey of the state was ordered, and the dearest ideal of the Academy triumphed.

But before the survey was ordered, and during its progress, our Transactions are exceedingly rich in papers on geology in its every phase. The first paper read before the Society was a geological paper by Professor Mudge, and at each succeeding meeting up to and including the twelfth, which was the last meeting previous to his death, he read from one to four papers on geological subjects, or twenty-four papers in all. One of these was a list of Kansas minerals, the beginning of a catalogue. Professor Mudge's record is also unique in that during his entire membership he was either president or vice president continuously, and did not miss a meeting. At the fifth meeting Wm. H. Saunders presented his first paper on the analysis of coal and limestones, and followed this with other papers on analysis of coals and clays, thus giving a very practical bearing to the work. Throughout our forty-seven years of existence geological papers have formed an important part of our programs. It is difficult to pass over this part of our work without extended notice of the work of such men as Williston, Hay, Haworth, Cragin, Prosser, Grimsley, Beede, Gould, Wooster, and many others. Our Transactions contain carefully prepared lists of invertebrate and vertebrate fossils, fossil plants and leaves, lists of minerals, with many valuable papers on every branch of the subject, both economic and scientific.

At the third meeting Prof. J. H. Carruth read a paper on the plants of Kansas, in which he dwelt largely upon species common in the western states that were not found here at all. At the fourth and fifth meetings he presented papers in which a beginning was made in the identification of Kansas species.

At the sixth meeting he presented a preliminary catalogue of the plants of the state. To this catalogue he made additions each year, except 1877 and 1881, until 1889, when, so far as I can learn, his last paper was presented. Professor Carruth was assisted by many local collectors, the Academy furnishing the unifying means. In 1881 B. B. Smyth began an extensive series of contributions, particularly of the plants of the western portion of the state, which was continued until quite recent times. In 1884 Professor Kellerman presented a preliminary catalogue of the parasitic fungi of the state, with their host plants. In 1888 and 1890 Professor Swingle presented a list of Kansas species of Peronosporaceæ. In 1894 Miss Reed presented an analytic key to Kansas mosses, with a list of the known species, and to this she made subsequent additions. Also, in 1894 Professor Hitchcock presented a list of the grasses of Kansas. In 1910 B. B. Smyth and Mrs. L. C. R. Smyth presented the first part of a revised catalogue of the plants of Kansas, and in 1912 Mrs. L. C. R. Smyth presented the second part, thus bringing the work up to date. This is a bare outline of the systematic work done in botany. There were many other contributors. However, I have given enough to show that through the Kansas Academy of Science as a unifying means the state has been given a fairly exhaustive catalogue of the different forms of vegetable life, and that our Transactions furnish the record of this work carried on for about forty years. Our Transactions show also much work of a more special character, and also work of a general educational nature. The following titles illustrate this class of work:

Black Rot of the Grape. Carpenter, 1887.
Hackberry Branch Knot. Kellerman, 1890.
Sorghum Smuts. Kellerman, 1891.
Characteristics of the Sand Hill Flora. Carleton, 1889.
Kansas Forest Trees Identified by their Leaves and Fruit. Kellerman, 1886.
Artificial Key to Kansas Grasses. Kellerman, 1888.
Evolution of Leaves. Mrs. Kellerman, 1890.

At the fourth meeting Professor Snow presented his first list of the birds of Kansas, to which he made many later additions. Colonel Goss, Professor Lautz and others also contributed to this list, the contributions by Colonel Goss being very extensive. So we have in our Transactions not only a very complete list of the birds of the state, but an extensive series of valuable papers on their habits and economic importance.

The work of Professors Snow and Dyche and Colonel Goss is particularly worthy of note, in that it has resulted in two splendid collections of mounted birds, the one in the museum of the State University, and the other donated to the state, and never yet adequately displayed, for want of room.

At the sixth meeting Professor Snow presented a preliminary list of the Lepidoptera of Kansas, and added to it from year to year until it is a practically complete catalogue of the Lepidoptera of Kansas.

At the seventh meeting Professor Popenoe presented a preliminary list of the Coleoptera of Kansas, and this has received extensive additions by Professor Snow, Mr. Knaus and others, and, as our program shows, is still in progress.

Professor Popenoe published a preliminary list of Kansas Hemiptera in 1884, and a list of Hymenoptera in 1885, both of which have received large additions.

Other lists published in our proceedings are: Catalogue of Kansas Mammals, by Knox; Catalogue of Kansas Fishes, by Graham; also, lists of serpents, clams, Orthoptera and Diptera, which I pass for want of time. Surely this work of classification alone would justify the existence of the Academy, and these published lists render the Proceedings very valuable; yet this is only one of a large number if lines of investigation carried on.

In meteorology the summaries published by Professor Snow formed for years the only available records on Kansas weather. This line of work was also taken up by Professor Lovewell at Topeka, and finally culminated in the establishment of a station of the United States Weather Bureau.

In chemistry, that many-sided subject, our Transactions are particularly rich. Beginning with the work of Professor Saunders in the fifth and seventh meetings, in which he presented analyses of coals, limestones and various clays, the chemists of the Academy have kept in close touch with the development of every branch of the subject, and nearly every volume of our Transactions contains valuable papers that touch our industrial development at its every point. The names of Kedzie, Patrick, Failyer, Bailey, Sayre, Willard, Franklin, Bartol, Cady, Dains, and many others are very prominent and deserve extended notice. Beginning with his paper, in 1883, on the utilization of mineral waters, Professor Bailey has pre-

sented about fifty papers, on food products, water supply, oils, and so on, but notably on foods; while Professor Sayre, beginning with his paper on loco weed in 1886, has presented about the same number, for the most part on the chemistry of drugs, spices, tea and coffee. The work of Professors Failyer and Willard is devoted largely to agricultural chemistry, in which line they have presented many papers.

In physics and engineering, our Transactions, beginning with the fifth meeting, contain a series of valuable papers by Tweeddale, Nichols, Blake, Smith, Marvin, Hoad, Murphy and many others, on a wide variety of subjects, from the theoretical to the most severely practical. Such titles as the following illustrate the character of this work:

On Ventilation. Tweeddale, 1872.

The Water Supply of Kansas. Tweeddale, 1874.

Statistics on Color-Blindness in the University of Kansas. Nichols, 1884.

Tests of Cement Manufactured in Kansas. Murphy, 1889.

Magnetic Declination in Kansas. Marvin, 1889.

Maximum Bending Moments for Moving Loads in a Draw Beam. Murphy, 1892.

Tests of Strength of Building Stones. Marvin, 1893.

Collection and Storage of Water in Kansas. Murphy, 1894.

Water Supply from a Sanitary Standpoint. Marvin, 1901.

Effect of Clay and Loam on Portland Cement. Hoad, 1904.

On Improved Water Supply for the City of Emporia. Smith, 1910.

Finally, in the forty-seven years of its existence the Academy has accumulated a library of at least 6000 bound volumes, and fully as many pamphlets. These represent the work of scientific investigators in all the leading countries, as well as our own, and form a very valuable addition to libraries of the state. This library has been secured almost entirely by exchange for the Transactions of the Academy.

I have thus sketched the growth and work of the Academy in an endeavor to emphasize the fact that from the beginning, when the state was new, and when scientific knowledge of its resources and of the composition of its plant and animal life was sadly needed, the members have attacked the problems at hand and carried them through the succeeding years, accumulating and recording knowledge of priceless value to the state. Much of the work has been classification—taking an inventory, as it were, but such work is imperative. I have also attempted to show that the Kansas Academy of Science has been the means

of unifying the work of the investigators—a central organization from which radiated the varied lines of investigation—and that in our Transactions we have in a body records that without some such clearing-house would be widely scattered, and probably many of them lost; also, without the stimulus of some such organization many of the records of work would never have been published.

Having thus reviewed the past, let us turn to the future. Has the need for such an organization ceased? The character of the work has indeed changed, but there exists even a greater need of scientific investigation, and in many more lines than in the early days of the state, and this need will increase as our civilization becomes more complex. We now have state boards, commissions, etc., that make their reports through different channels, but in each of these there are questions without number of a purely scientific character that find no place in such reports. Such questions should continue to be worked out in our meetings and the results published in our Transactions. The work in botany has changed to the search for or breeding up of plants better adapted to our economic needs, and to combating injurious parasitic forms. The immediate usable results of such work should of course be given to the people in bulletins, but the scientific investigations should not be lost. These should find a place in our Transactions. In the most ordinary experiment in plant breeding, even one that produces no commercial results of value, often some exceedingly important new facts in heredity are brought to light that should be given publicity. Then there are numberless new developments just ahead of us. What thoughtful person who considers the development in the cement industry, with its almost revolutionary effect on engineering and architectural construction, will dare to say that we have reached the limit of our mineral resources? Yet this is a thing of the present, undreamed of when the Academy was organized. Our clays have only begun to yield their wealth, and in every line we are merely at the beginning of our development of mineral resources. In engineering there is an immense field opening. We in Topeka are still buying 10-cent electricity, while the Kansas river is carrying by each day enough of the same article at 2 cents to supply our every need and add greatly to the comfort of living. Irrigation, conservation and control of flood waters are also problems of the immediate future. There

is no lack of room for work for such an organization; indeed, the amount and variety of work pushing to the front is so great as to be almost bewildering. It is clear to me that the Kansas Academy of Science has a greater opportunity to do beneficial work for the state now than it has ever before had, and this opportunity will increase with the years. It now remains for us to consider our present organization and environment, and determine the changes that would increase our efficiency.

The first thing that must appeal to us is lack of room. Crowded as we now are, even sharing our quarters with another organization, we can not command the facilities absolutely essential. We are not now and have never in our entire existence been able to arrange our library in shape for ready reference. This need, I understand, will be provided for in the quarters provided for us in the new Memorial Building, which by a happy coincidence occupies the site of the Lincoln College building, in which the Academy was organized. Whatever provision is made should include ample room for arranging our books in the most convenient and useful way; also, we should there have a complete up-to-date card catalogue, in order that our volumes may be of maximum use to the entire state.

Next, it seems to me, the Academy should have a separate existence. While we have received courteous, even generous, treatment at the hands of the Agricultural Society, of which we are a coördinate branch, and have only kind words for that society, yet there is a decided advantage in an independent existence, really an advantage to both organizations. The work of the two organizations, while somewhat related, is yet so distinct, and the methods of accomplishing this work so radically different, that I can see no gain to either organization in such a union as now exists.

Third, and most important of all, we should secure a change that will permit us to publish our Transactions annually, and as soon after the annual meeting as is possible. It is a very decided detriment to the Society to have to wait two years for their appearance. Other societies, outside our state, but with which we must in a definite way compete, publish more frequently, and thus secure members who are doing scientific work in our state, that, as I see it, ought to find a place in our

Transactions. It is a well-known fact that many workers, particularly in engineering, do not join us for this very reason. Every legitimate effort should be made to remedy this defect at the earliest possible date.

There are other minor adjustments that could probably be made with benefit to the Academy, but the above three seem to me so important that I earnestly recommend them to the careful consideration of the Academy.

With these modifications accomplished, it seems reasonable that we should be in position to largely increase our membership, and thereby the usefulness of the Academy. In three more years we will celebrate our fiftieth anniversary. Would it not be possible on that occasion to have our present membership doubled? It seems entirely reasonable to me, and worth trying. If accomplished, we could enter our second half-century with an impetus that would insure large success in our work of gathering, shaping and disseminating useful knowledge in all lines of scientific research.

II.

MATHEMATICAL AND GEOLOGICAL PAPERS.

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1. "A Probable Origin of the Rings of Saturn."
   By Albert B. Reagan.
2. "The Marine Tertiary Stratigraphy of the North Pacific Coast of North Amerca."—A Review.
   By Albert B. Reagan.
3. "Deep Wells at Elmdale."
   By Alva J. Smith.
4. "Kaw Valley Anticline."
   By E. C. Warfel.
5. "The Chert Gravels of Eastern Kansas."
   By L. C. Wooster.

A PROBABLE ORIGIN OF THE RINGS OF SATURN.

By Albert B. Reagan.

IN the Student's Reference Work Cyclopedia, volume 2, page 1140, is this description of Saturn:

"Saturn, with its system of rings, is conceded to be one of the most superb objects in the heavens. Although the diameter of the planet is only 73,000 miles, the outer ring is no less than 168,000 miles across. Two rings have been known for a long while, but a third ring was discovered by Bond in 1850. Pierce and Maxwell have proved that these rings are made up of discreet particles, and that the rings, therefore, are neither solid nor liquid. The planet has eight satellites, discovered between the years 1665 and 1848."

Saturn's rings are kept in place by the same force as are its satelites. But how did they get in their present position, and where did they come from?

Some astronomers—practically all, in fact—no doubt believe that each ring of Saturn was left in its present position when the planet cooled to a less size than the respective rings; and many believe that probably these rings may develop into moons in time by the segregation of the particles of each respective ring. But may it not be probable that they had a different origin? May they not have been formed by titanic volcanic eruptions of that planet? Let us compare some of the most violent volcanic eruptions of the earth in our own time, and then see if the same phenomena, only on a more gigantic scale, might not have occurred on Saturn and produced the rings.

ALASKAN VOLCANIC DISTURBANCES.

In the recent violent volcanic disturbances in Alaska it is a known fact that volcanic ashes were hurled 2000 miles, and the finer dust particles were carried in the atmosphere completely around the earth. They were observed in Algiers and elsewhere. It is also even believed by some observers that the mean temperature of the earth's surface was lowered for a time by these dust particles being suspended in the upper atmosphere.

THE ERUPTION OF MOUNT PELEE.

"The eruption of Pelee, that in its intensity, short duration and annihilating power must be ranked among the great ca-

tastrophes recorded in history, establishes a new chapter in the science of vulcanology, and illuminates a new page in the physics of the globe. A mountain hardly more than Vesuvian proportions, without lava discharge, without accompanying earthquake disturbances, sends to utter destruction, in a few seconds, a town and suburbs with a population conservatively estimated at 30,000, of whom only two escaped and but one survives. Eighteen or more vessels in the harbor were destroyed by burning or capsizing, and most of the human freight which they carried shared their destruction, An extensive region of fields and forest lands was blistered, singed or turned into a desert, while torrential flows of mud and giant boulders annihilated settlements lying beyond the direct action of the volcano itself. . . . This is the story of the catastrophe (cataclysm) whose exact nature is unique in the annals of science."—Anglo Helptin, *Fortnightly Review,* pp. 475, 476.

THE CARIBBEAN CATACLYSM.

"The explosion of Mount Pelee, on the Island of Martinique, on May 8 (1902), whereby the city of St. Pierre was in a few seconds completely destroyed and 30,000 or more people were killed, is one of the most extraordinary manipulations of volcanic power that have ever been known. . . . The 'volcanic blasts' of hot gases and superheated steam, which appear to have been the chief agents in the destruction of life, are unprecedented in the history of such disasters."—Garrett P. Serviss, *Cosmopolitan,* July, 1902, p. 357.

I will also add that at the time of the eruption of Mount Pelee I lived at Cibicu, Fort Apache Indian Reservation, Arizona, and there red sunsets were distinctly seen as a result of the dust particles hurled from Pelee into the upper atmosphere. Furthermore, on May 9, before I had heard of the volcanic disturbance, a sheet spread out on the grass in my yard was noticed to have fine dust particles on it, which proved to be volcanic ashes. I also saw in some paper later that such dust was also detected about Phœnix, Ariz.

THE ERUPTION OF KRAKATOA.

"The first great (ocean) waves on the evening of the 26th and the early morning of the 27th (of August, 1883) were caused by a portion of Krakatoa being shot out northward eight miles and dropped where we now have Steer's Island;

while the appalling detonation in that forenoon and the greater wave accompanying it resulted, perhaps, from that still more titanic effort which lifted the greater portion of Krakatoa—several thousand million cubic yards of material—out of its 170-fathom root, hurled it through the air over Lang Island, and plunged it into the sea some seven miles to the northeast, where Calmeyer Island now blocks the channel, which marines have known so long as East Passage. . . . To what height the supreme outburst propelled the smoke, dust, and the lighter portion of matter, it is impossible at present to estimate. Mr. Whymper saw Cotapaxi, in by no means one of its extraordinary expirations, eject a column over 20,000 feet in height; but many multiples of this distance will doubtless be required to measure the spire that was shot skyward on the afternoon of August 27 last. At least it rose so high that months have been required for it to descend."—*Popular Science Monthly,* vol. 25, pp. 373, 374, 375.

In speaking of the eruption of Krakatoa, Johnson's Mineral Encyclopedia (vol. V, p. 26) says: "The eruption began in May (1883) and continued till August 27, when a large part of the island was blown away and fragments of pumice and dust thrown to a height, by estimate, of twenty miles. Gaining the region of the upper air currents, the dust was carried around the entire earth, and produced wonderful twilight glows for many months. The sound of the explosion was heard at a distance of 2247 miles. The waves produced in the air traveled four and one-half times around the world. Sea waves fifty feet high swept the neighboring shores, and similar waves were observed on distant coasts over half of the globe. One hundred sixty-three villages were destroyed and 36,380 human beings perished."

Could not the discreet particles forming Saturn's rings have been hurled into space from the planet in some tremendous volcanic cataclysm in the same way as Krakatoa hurled her dust particles beyond the upper region of our atmosphere, so that it took it two years to return to the earth again. If such occurred, the rings would, of course, be distant from the planet in proportion to the immensity of the eruption that hurled the particles of the respective rings into space; and if hurled far enough into space, gravity and counter forces would prevent them from returning to Saturn. The motion of the planet

would tend to have them form as bands over the equatorial region, as I understand they do. The eruption of Krakatoa is one of the very insignificant eruptions of our earth, if all geological time is considered; yet its immensity is beyond comprehension. Saturn, without its rings, has nearly nine times the bulk of our earth, and probably even more than double that in its tendency to stupendous volcanic activity.

THE MARINE TERTIARY STRATIGRAPHY OF THE NORTH PACIFIC COAST OF NORTH AMERICA.

Review of an article by Ralph Arnold and Herold Hannibal.

By Albert B. Reagan.

I HAVE not the time to review the whole of the above-cited article of Ralph Arnold and Herold Hannibal, but will touch only the part that relates to my article, "Some Notes on the Olympic Peninsula, Washington." (Transactions of the Kansas Academy of Science, vol. XXII, 1908, pp. 131 to 238.)

In the article of the two gentlemen cited, page 604 (Reprint from Proceedings of the American Philosophical Society, vol. LII, No. 212, November-December, 1913) is this paragraph:

"A. B. Reagan, 1908, 'Some Notes on the Olympic Peninsula.' Most of the geological data in this paper are adopted from one by the senior writer (Arnold) mentioned. . . . The description of the Quillayute formation is based on the glacial filling of the valley of the Quillayute river. If Reagan had visited the locality from which the fossils he describes from the Quillayute formation were brought by the Indians, he would have found it to be about two miles from Devil Club swamp, where he says they occur, and the formation lithologically very different from what he describes. It is typical Empire formation."

I will take up Mr. Arnold's misstatements as they come:

"Most of the geological data in this (Reagan's) paper are adopted from one by the senior writer (Arnold)."

I had done my geological research work and was at Leland Stanford, Jr., University classifying the fossils described in my article when Prof. J. P. Smith (I believe it was) gave me Mr. Arnold's article on the Olympic Region (Geological Reconnaissance of the Coast of the Olympic Peninsula, Washington; Bul. Geol. Soc. America, vol. 17, pp. 451-468, vols. 55, 56.) In the final writing up of the article I did quote from this article, and wherever I did I gave Mr. Arnold due credit for the same, as the article shows; but that most of the data was adopted from Mr. Arnold is preposterous. Mr. Arnold's whole article covers pages 451 to 468, or a total of 18 pages, and my article cited covered from pages 131 to 238, or a total of 108 pages, besides plates. Had I copied Mr. Arnold's article *in toto* it would have been only a small fraction of my article. Furthermore, I described the Quillayute and interior region

of the peninsula, which Mr. Arnold touched only slightly, if at all.

"If Reagan had visited the locality from which the fossils he describes were brought by the Indians, he would have found it to be about two miles from Devil Club swamp, where he says they occur, and the formation lithologically very different from what he describes. The (Reagan's) description of the Quillayute formation is based on glacial filling of the valley of the Quillayute river. (But) it is typical Empire sandstone." (Written in reverse order to bring out Mr. Arnold's statements.)

I am sorry Mr. Arnold never read my article. He can read the English language, I am sure; and if he ever read my article he certainly would not have made the statement above quoted. My article is in your libraries, and I beg you to please get down the volume cited and see for yourselves that the statements above are far from justice to me.

I visited the region and collected the fossils described myself, with the exception of the fossil *Ranella marshalli,* which was given me by Mr. Marshall, as is stated on page 224 of the article. I made a good many trips to the place, both with white men and with Indians. We went both by canoe up the river and also on foot in from Quillayute prairie. James Clark, now county commissioner of Clallam county, Washington, accompanied me on the first trip. George Woodruff, now of Ilwaco, Washington, was with me on another trip. On practically all the trips I crossed the Devil Club swamp from the bend in the river to the bluffs adjacent and north of where Maxfield creek entered the Quillayute river when that river ran against the western bluffs, instead of about a half a mile eastward as it does now (at the old mouth of Maxfield creek; not a later mouth of Maxfield creek). *There is not a statement anywhere in my article that a fossil was obtained in the Devil Club swamp or any material of which the Devil Club swamp is composed.*

I will now quote from page 203 of my article:

"*Quillayute Formation* [This is under the general heading 'Pliocene,' on page 202]. This formation occupies the valley of the Quillayute river and the country drained by its eastern tributaries at least to their respective middle courses, thence westward to Wasatch strait, the formation extending outward to the coast now and then. The boundaries of the formation were not ascertained. In the interior region, where exposed along the Bogachiel river, it is composed of sandstone and bluish-gray shale; the coast exposures are all conglomerates or a coarse gravelly rock resting unconformably upon the older rocks exposed there.

The base of the formation was not seen in the interior region. The thickness of the formation, consequently, was not ascertained. The sandstone series was found to be extremely fossiliferous, and in it the fossils are beautifully preserved. Fossils were found at two horizons—in the north bank of the Bogachiel river in a bluish-gray rock in section 22, township 28 north, range 14 west of the Willamette meridian, and *in the bluff south of the abandoned channel of Maxfield creek* on the south side of the Bogachiel river, in sections 28 and 29 of the township and range above. But fossils were obtained only from the latter location, as the former was below the surface of the water of the river at the time visited. Below is a description of the fossils obtained.

"*Fossils of the Quillayute Formation (Lower? Pliocene) Exposed in the Vicinity of Quillayute, Wash.*" [There follows a two-page comparison of the Quillayute formation fossils with the fossils of other regions, with the final conclusion, page 205, that:] "Consequently, this [the comparison-results] would seem to place the formation at the bottom of the Pliocene. Following is a description of the fossils." [Here follow twenty-two pages—from pages 205 to 226—describing the fossils of the Quillayute formation.]

I am unable to find anything in my article that states that the Quillayute fossils described by me were found in a Devil Club swamp or that they were found in glacial drift. Moreover, on page 589 (of the cited article) Messrs. Arnold and Hannibal state that the Empire formation in the Empire district, Oregon, is composed of "about 500 feet of beds, sandstones at the base, grading upward into massive shales, partially organic in character."

To quote from my article, paragraph on the Quillayute formation above mentioned (page 203): "In the interior region, where exposed along the Bogachiel river, it (the Quillayute formation) is composed of sandstone and bluish-gray shale; the coast exposures are all conglomerates or a coarse gravelly rock resting unconformably upon the older rocks exposed here."

My description, accompanied by the description of fossils obtained, shows conclusively that the Quillayute formation is a typical Empire sandstone and shale.

DEEP WELLS AT ELMDALE.

By Alva J. Smith.

TWO deep wells have recently been drilled at Elmdale, Chase county, Kansas, one reaching a depth of 1228 feet and the other 2501.5 feet. The first one was drilled within the town, about three blocks east of the depot; the other was on the north bank of the Cottonwood river, on the county farm, about one-half mile west and two miles south of Elmdale.

The section presented herewith is of the well drilled on the county farm. The ground at the top of the well is at an elevation of approximately 1200 feet above sea level and level with the Americus limestone, which crops out on the opposite bank of the river.

The work was done with a Standard drilling rig and wire cable. The fuel used was natural gas piped from an adjoining well.

In naming the formations of the section I have tried to follow the nomenclature that had been approved by the University Geological Survey in preference to that used by the United States Geological Survey. While the correlation of the strata may not be, and probably is not, absolutely correct, I have tried to make a reasonable interpretation of data at hand. The logs are submitted as given by the drillers. The log from which the section was made omits two limestones near the top that are reported in the other well.

Gas was found in five different sands, the first at a depth of 140 feet; the strongest flow was at 615 feet, and the last at about 2000 feet. No attempt was made to gauge the pressure or measure the quantity of the gas in any case.

The Cherokee shales are more than 800 feet thick, and some of the sandstones included in it are very hard. In one place the drillings contained quartz, mica and feldspar, and the drillers contended that they were in granite, but later several hundred feet of sand was penetrated beneath it. The contract called for a depth of 2500 feet; accordingly, when the drill reached a depth of 2501.5 feet the casing, of which there was about 5000 feet, was drawn from the well. The last sample washed from the drillings is a fine, sharp quartz and feldspar

sand with a few black grains in it. Most of the grains range in size from $^1/_{10}$ to 1 mm. in diameter. At a depth of 600 feet a flow of artesian brine was struck, which ran from the top of the well in a small stream to the river. An analysis of the water gave the following results in parts per million:

Analysis of Water from the Elmdale Well. Depth, 600 Feet.

Specific gravity	1.075
Total solids	116,500.00
Alkalinity	12.00
Chlorine (Cl)	65,000.00
Sulphate (SO_4)	20.00
Calcium (Ca)	1,200.00
Magnesium (Mg)	1,640.00
Iron (Fe)	.75

Well on County Farm, Elmdale.

	Formation.	*Depth, feet.*		*Formation.*	*Depth, feet.*
2	Soil	2	45	Lime	885
33	Clay	35	10	Slate	895
10	Gravel	45	5	Lime	900
3	Lime	48	65	Slate	965
17	Slate	65	10	Sand	975
5	Lime	70	5	Lime	980
60	Slate and shells	130	50	Slate	1,030
10	Sand, gas	140	5	Lime (Kickapoo)	1,035
50	Slate	190	25	Slate	1,060
20	Sand, water	210	5	Lime	1,065
30	Slate	240	80	Slate	1,145
10	Lime	250	20	Lime	1,165
30	Slate	280	5	Sand, gas	1,170
20	Lime	300	20	Lime	1,190
5	White slate	305	4	Slate	1,194
10	Lime	315	30	Lime	1,224
15	Black shale	330	4	Slate	1,228
10	Lime	340	7	Lime	1,235
5	Sand	345	20	Slate	1,255
5	Lime	350	70	Lime	1,325
5	Shale	355	5	Slate	1,330
15	Lime	370	40	Lime	1,370
70	Slate	440	10	Slate	1,380
10	Lime	450	15	Lime	1,395
40	Slate	490	5	Slate	1,400
5	Lime	495	5	Lime	1,405
15	Slate	510	15	Slate	1,420
5	Lime	515	30	Lime	1,450
10	Shale	525	5	Slate	1,455
10	Sand, gas, water	535	35	Lime	1,490
30	Slate	565	5	Slate	1,495
5	Lime	570	5	Lime	1,500
5	Slate	575	95	Slate	1,595
25	Lime	600	10	Black slate	1,605
5	Slate	605	15	Lime	1,620
10	Sand, strong gas	615	20	Slate	1,640
35	Slate	650	20	Lime	1,660
10	Lime	660	5	Black slate	1,665
15	Slate	675	30	Slate	1,695
15	Lime	690	5	Dark slate	1,700
30	Slate	720	7	Slate	1,707
15	Lime	735	48	Sand and gravel	1,755
10	Slate	745	25	White sand	1,780
20	Lime, pink	765	25	Granite	1,805
10	Slate	775	142	Red sand	1,947
10	Lime	785	7	Black sand	1,954
20	Black shale	805	16	Red sand	1,970
35	Slate	840		Light sand to bottom of hole,	2,501 $^1/_2$

Hole was dry below 1700 feet; gas at about 2000 feet.

Well in Elmdale.

	Formation.	*Depth, feet.*		*Formation.*	*Depth, feet.*
6	Soil	6	3	Lime	630
30	Clay	36	10	Shale	640
8	Sand and gravel	44	15	Sand, water	655
24	Black shale	68	4	Shale	659
14	Lime	82	3	Lime	662
10	Black shale	92	8	Shale	670
8	Sand, gas	100	2	Shale	672
34	Shale	134	15	Lime	687
8	Lime	142	3	Shale	690
29	Shale	171	13	Lime	703
8	Lime	179	16	Blue slate	719
16	Shale	195	6	Lime	725
33	Sand, gas	228	10	Shale	735
7	Blue shale	235	3	Lime	738
20	Shale	255	10	Shale	748
30	Black shale	285	2	Shale	750
5	Lime	290	15	Lime	765
10	White shale	300	30	Shale	795
15	Black shale	315	5	Lime	800
1	Lime	316	5	Shale	805
4	Shale	320	6	Lime	811
7	Lime	327	5	Shale	816
6	Shale	333	21	Sand*	837
10	Shale	343	3	Shale	840
6	Lime	349	5	Shale	945
10	Black shale	359	20	Light shale	965
5	Lime	364	35	Lime, hard	900
2	Black slate	366	5	Black shale	905
22	Lime	388	22	Lime	927
5	Lime	393	20	Sandy lime, water	947
8	Shale	401	5	Dark shale	952
5	Lime	406	8	Lime	960
45	Shale	451	30	Sandy shale	990
33	Lime	484	5	Sand, water	995
35	Shale	519	10	Sandy shale	1,005
5	Lime	524	20	Light shale	1,025
12	Shale	536	10	Salt sand and water	1,035
8	Lime	544	5	Lime (Kickapoo)	1,040
6	Black shale	550	100	Light shale	1,140
10	White shale	560	30	Lime	1,170
30	Shale	590	5	Black shale	1,175
25	Lime	615	10	Lime	1,185
5	Shale	620	3	Light shale	1,188
5	Lime	625	40	Lime	1,228
2	Shale	627			

* With showing of oil and gas, but on account of the hole being full of water there was no way to determine how much, as it would take probably a five-million well to throw the water out. In order to determine what was there we would have had to ream down and set 13-inch pipe.

KAW VALLEY ANTICLINE.

By E. C. Warfel.

ABOUT 1883, Prof. I. C. White, of the United States Geological Survey, was employed to see if it were possible to determine whether gas and oil deposits might be located from a scientific standpoint. Professor White, in his report upon such investigation, said that after examining all of the great gas and oil wells of western Pennsylvania and West Virginia he found that every one of them was located either directly on or near the line of an anticlinal axis, and which was the origin of the anticlinal theory. He further found that wells drilled in the same region, and not on the anticlines, were found to be void of gas and oil, and usually productive of large quantities of salt water.

To the uninitiated I would say that an anticline is an upward thrust or bulge in the earth's strata from the original horizontal position.

A wide investigation both in reading and in personal observation leads the writer to conclude that wherever water has penetrated the strata neither gas nor oil will be found in the syncline, but only on or near the axis or apex of an anticline, and then only when it is capped in on all sides and there has been no eruption through to the surface; the theory being that the water forces the gas and oil out of the strata until it goes to where it can go no further and then collects and is held up and put under pressure by the water. So if a well-capped anticline is found, and there are layers of shale rock beds or impervious rock above it, one may reasonably look for gas or oil in or near the dome thereof. These uplifts or anticlines need not be very high, as some of those in southeast Kansas and northeast Oklahoma which the writer has personally examined are about forty feet in elevation above their extreme edge and spread out several miles in width and length; but these small ones usually produce only in small strips along the axis, and sometimes when one end of the axis is lower than the other even the lower end of the axis is unproductive. So while one might miss finding gas and oil in an anticline, yet practically it is the only place to start prospecting, as nearly

all the gas and oil fields are so situated, notable exceptions being northeast of Ponca City, Okla., where there was a dry sand and the oil was found in the syncline.

It would appear that at the time of some of the Ozark uplifts in the later geological times a line of bulges or anticlines was formed in a ring clear around the Ozark region at a distance varying from sixty to more than a hundred miles, being closer to the south and southwest than on the north and northeast. Then there appear smaller ones in the region between the great ring and the mountains, and as this great anticlinal ring is where usually the entire Carboniferous age is in place, it forms an ideal condition for the collection and preservation of gas and oil, and on which line or ring are located the Cushing field, Ponca City, Newkirk, Okla., and the Arkansas City, Baxter, Augusta, Elmdale and Wilsey fields, recently developed, and which appear to be only starting; and then the Illinois fields are on the same line. On this ring is located the great Kaw valley anticline, which is particularly under discussion, and appears to be the largest one yet definitely located and of rather an unusual shape; this great ring being composed of domes in two lines running from four to twelve miles apart.

This one is located about forty-five miles west of Topeka and extends across the Kansas river, the extreme edges about twenty miles east and west and about thirty or forty miles northeast and southwest, and it might be compared in shape to a great inverted meat platter, there being a wide outer ring many miles in width, sloping very gradually, while in the middle there is an area about four miles wide and nine miles long that is practically horizontal; and then between this interior portion and the above-mentioned outer rim there is a dip amounting to about 200 to 300 feet to the mile and about two miles wide. There is, however, a dip in the middle of the dome, or the bottom of the dish, thus leaving the highest part in the form of a ring around the edge of the dome, it appearing that the upthrust was so wide that the weight in the middle caused it to settle back to some extent.

This dome was first noted, so far as the writer can learn, by the United States Geological Survey about the year 1853, but no economic value was attached to it at that time, and only within the past few weeks did I learn that it had been so noted.

In about 1910 Dr. J. W. Beede, while working for some private parties, seems to have discovered the southeast edge of this dome, but appears not to have extended his investigations to the west edge, apparently thinking it to be the usual form, having the dip to the east and a monoplane to the west. However, further investigations disclosed the form mentioned.

The elevation is comparatively very great, being as much as 600 feet above the outer edge on the east, as the Burlingame limestone that was found 600 feet deep at McFarland is an out-cropping surface rock across the dome.

In the fall of 1913 a company was formed to prospect this anticline for gas and oil, and practically the entire dome of the anticline was leased and a prospect hole commenced at a point about a half mile south of Zeandale, on the Rock Island railway, and continued to a depth of 955, where granite was claimed to have been encountered. If so, a new discovery was thus made which is now puzzling all the geologists in the country, it being found at about the horizon of the Pleasanton shales. At McFarland, about fourteen miles southeast, a well was drilled by the Rock Island Railway Company to a depth of 2000 feet and penetrated the Cherokee shales only 174 feet, which are probably about 650 feet thick. Counting off the 600 feet of bulge would make the bottom of the Cherokee shales on the anticline 1876 feet deep; and judging from the deep wells at Caney and Iola, it would appear that this so-called granite is at least 3000 feet out of place, and probably much more.

Various reasons for its presence at this horizon have been advanced, one being that an ancient mountain range lies buried along this anticlinal fold, and that the bulge of the dome was caused by a new uplift of the old mountain range. Another and more probable explanation, if it is granite, is that, the uplift being so great, the breaking of the strata at the edges of a steep dip caused the crevices through which the molten matter of the interior of the earth intruded itself in the form of dikes, and that as the holes drilled are directly on the edge of the steep dip to the west, they struck this crevice and penetrated this dike, which is probably in the form of a vast wedge, and may be several hundred feet, even thousands of feet, in depth. It is not likely to be a vast sheet that was run out by some old volcano and spread over the

surface while this horizon was the surface, as in that event it would not have had the pressure commonly considered necessary to the crystallization of granite. The writer is not yet satisfied that it is granite; but whatever it may be, it is something apparently unknown in Kansas before, and it appears that at Elmdale, Kan., it has since been encountered at about the same geological horizon, it there being reached at about 1700 feet from the surface, but the erosion in the Kaw valley and the variation in the thickness of the strata would account for the difference. Another interesting feature of this anticline is that many of the strata, both of shale and limestone, are heavily mineralized, and while the ledges are continuous, yet in many places the texture so changes that they would hardly be recognizable under the general characteristics of the ledge.

One other interesting feature of this is the partial nonconformity of the strata of the carboniferous formations, it being found that on the north side of the river the heavy ledge of the Emporia limestone lies about fifty feet above the lower blue Emporia, and the Burlingame limestone about thirty feet below the Emporia blue, while toward the west of the dome, and on the south side of the river and near the line between sections 27 and 28, these shales thin out and the Burlingame is bulging upward, while the heavy Emporia dips downward, approaching each other to within about twenty feet. This evidently shows a surface shifting during the formative periods of the rocks.

These conditions and the minerals found in the rocks and shales would suggest to me that during all of the formative period of these strata there may have been an under-water vent from the interior of the earth, through which minerals in various forms were thrown out and mixed with the mud and shell deposits, and thus deposited with the regular strata; and that vastly more interesting discoveries are likely to be found in this region than are now made.

Ever since white men settled in this region earthquake shocks of more or less violence have been felt at frequent intervals, varying from slight tremors to violent shocks that threw down chimneys, cracked stone buildings and threw frame buildings from their foundations, and said to be as heavy as the one that wrecked San Francisco. So it may be

that some of the farmers of Waubaunsee and Riley counties are sleeping peacefully over the slumbering vent of some ancient volcano, liable to break forth at any minute and send them and all their possessions heavenward before they are prepared to take that journey, and that an upheaval of a more general nature may be pending that may any day change the peaceful prairies of Kansas into jagged mountains, and Nature thus show that there is a power greater than a Kansan's bank account or a Kansas political pull.

THE CHERT GRAVELS OF EASTERN KANSAS.

By L. C. Wooster.

WHILE these chert gravels have been seen by the author of this paper in several other counties of eastern Kansas, they have been specially studied by him only in Greenwood, Lyon and Morris counties. The general features of this deposit are the same, however, wherever seen.

These chert gravels are found capping the highest bluffs, are less abundant on their slopes, and are plentiful again in the river and creek channels and beneath the bordering bottom lands. The thickness of the deposit varies from nothing up to ten or more feet, and the gravel is usually less than five inches in diameter. Its color varies from light buff, sometimes almost white, to a yellowish brown, the gravel longest exposed to the atmosphere averaging darkest in color. Many pieces contain fossils of the common Coal Measure and Lower Permian types. *Productus semireticulatus*, *Athyris subtilita*, *Fusulina cylindrica*, and various species of cup corals, crinoids and lace corals are most common.

The chert and the included fossils of the gravel are very similar to the chert and included fossils of the Wreford limestone of the "Flint Hills" in the adjacent north-and-south tier of counties to the westward. All the strata in this part of Kansas dip at a low angle to the westward, and the "Flint Hills" are slowly receding in the same direction under the eroding influence of atmospheric and aqueous agencies, and the chert gravel undoubtedly represents the resistant debris of the Wreford and Florence limestones left on the peneplain to the eastward. These Lower Permian limestones stretch across the state in a general north-and-south direction, and, since they must have been receding westward during the twelve million years that have elapsed since the close of the Paleozoic era, when eastern Kansas was lifted out of the seas for the last time, they have left a belt fifty or sixty miles wide strewn more or less thickly with their chert. In the Kansas river valley and north, the drift left by the Kansas glacier lies next above the gravel or is mixed with it.

Several interesting inferences to the student of geology may be derived from a study of these gravel deposits.

1. Were the Wreford limestone still at Emporia it would have an elevation of about five hundred feet above the Emporia series of limestones; therefore five hundred feet of rock strata has been removed by the erosive agents from central Lyon county since the "Flint Hills" were over this locality. If the average rate of denudation was that of the Mississippi basin, one foot in about five thousand years, then it has taken two million five hundred thousand years to remove these five hundred feet. The average recession westward of the "Flint Hills" during this time has been about fifteen miles, except in the river valleys, where the recession has been much greater. To have made a recession of sixty miles would have required, at this rate, ten million years. This confirms the estimated time of recession, twelve million years, as the width of the belt covered with chert gravel is more than sixty miles rather than under.

2. While Mr. Alva J. Smith was superintending the excavating necessary for a sewage disposal plant near Council Grove, Morris county, in the bottom lands bordering the Neosho river, he found several interesting relics of a previous civilization in undisturbed river silt and gravel. Resting on a stratum of limestone on a level with the bed of the river Mr. Smith found about three feet of blue clay in which were sticks of wood and the faint impression of a leaf. On this blue clay rests three feet of chert gravel. In the lower part of the gravel he found a spear head of chipped flint of crude workmanship, and an arrow point of the same material but of better shape. On the gravel rests twenty feet of river silt, constituting the main thickness of the bottom land, except at the margin, where it thins out and the gravel emerges. The latter stretches as a thin sheet up the slope of the river bluff to the top, where it thickens and caps the bluff. In the excavation in the bottom land, several rods back from the river, Mr. Smith discovered in the silt, thirteen feet below the surface, the bones of a bison, and ten feet deeper he found another arrow point of chert (flint). A tree stump on the surface of the bottom land near the excavation showed one hundred and seventy-five annual rings, and yet its roots showed scarcely any burial by silt from the river overflows.

3. While excavating for a well in the river bottoms at Eureka, Greenwood county, the workmen found just above the

chert gravel, at a depth of twenty-eight feet, the bones of a Quaternary horse, possibly *Equus major* DeKay. The bones were those of a horse larger than those of the modern animal, and, with the exception of the teeth, were badly disintegrated. One molar tooth measured three and one-fourth inches from the grinding surface to the beginning of the roots. The latter were broken at the ends and the cavities partly filled with calcite crystals. With the bones of the horse was found the cast of the shell of a river mussel of the family Unionidæ, and near the modern species *Quadrula plicata.*

4. The continued rise of the Ozark mountains of Missouri and of the Arbuckle and Wichita mountains of Oklahoma during the Paleozoic and Mesozoic eras gave the strata of Kansas a dip to the northwest and southwest, which they retained till the middle of the Cenozoic era. At this time the rise of the Rocky mountains reversed the dip of the strata in the western half of the state, greatly reduced the westward dip of the formations in the eastern half, and changed the trend of the rivers from west into the western Mediterranean to east and southeast into the rivers that make their way to the Gulf of Mexico. At the same time the rivers were rejuvenated and their work of forming a new base level was begun.

Following these orogenic movements came two or three warpings of the earth's crust in North America, which gave new phases to the problems relating to the distribution of the chert.

The geologist has proofs that early in the Glacial epoch the northern portions of our continent were elevated till they were much higher than now. Probably the increased elevation was three thousand feet at the latitude of Lake Superior and five thousand in the neighborhood of Hudson Bay, according to Dana. This high latitude elevation of the continent must have given the south-flowing rivers a much greater velocity than at present, and thus have caused them to excavate their valleys very deeply and to a great breadth. The rivers of Lyon and Greenwood counties have eroded their channels to an average depth of more than one hundred feet below the level of the highlands and to a width of from one to four miles. As these river valleys must have taken their present shape and direction since the rise of the Rocky Mountains in the Tertiary period, and have been excavated since the beginning of the

Glacial epoch, when the rivers received sufficiently high velocities through the elevation of northern lands, we have in this work of excavation, especially, a time measure of some value. At the rate of one foot in five thousand years, the work of excavating valleys one hundred feet deep would have taken five hundred thousand years, or approximately one-half of the time from the beginning of the Glacial epoch to the present. It should be remembered that only the northeastern portion of Kansas was invaded by glacier ice, that of the Kansas glacier, and the balance of the state was being denuded all the time by the atmospheric and aqueous agencies. So during all of the Glacial epoch in most of the state, and during the major portion of the time in the glaciated part, the rivers with plenty of water of high velocity deepened and broadened their valleys to near their present depth. At that time the floor of the valleys must have been covered with a layer of chert gravel from three to five feet thick, composed of the debris of the Wreford and Florence limestones, together with the flint (chert) weapons used by the aborigines of Kansas.

East of the sixty-mile-wide belt covered by the residuum of the "Flint Hills" are still other chert gravels derived from the Oread and Dennis limestones, and still farther east, mostly in Missouri, are the abundant chert gravels derived from the Mississippian limestone.

During the Champlain epoch the previous up-warping of the Glacial epoch was reversed, and the northern lands sank to a level of from three hundred to one thousand feet, according to Dana, below that possessed at present. This subsidence caused the south-flowing rivers to become sluggish and to deposit sediment rapidly. The Neosho, Cottonwood, Verdigris and Fall rivers, and probably other streams in the "Flint Hills" gravel belt, buried the chert gravels to a depth of twenty or more feet with river silt, but with increasing slowness as the bottoms increased in height.

During the Recent epoch the northern lands have recovered in part the elevation they possessed during the Glacial epoch; the rivers have increased their velocity and are again cutting into the rock strata. The rivers so rarely overflow their banks at the present time that the bottoms are scarcely holding their own in the struggle for existence. The tree stump at Council Grove showed no burial of its roots by silt, and its

rings of growth showed that the tree had stood one hundred seventy-five years on this bottom.

As to the time of burial of the chipped flint (chert) weapons at Council Grove and of the horse bones and teeth at Eureka there is at present no agreement among geologists. The indications are that these relics were buried at about the close of the Glacial epoch. Some geologists fix that time at twelve thousand years, others at thirty thousand, some fifty thousand, and still others make the time one hundred thousand years ago. The author of this paper would estimate that they have been buried at least twenty-five thousand years.

III.

PHYSICAL AND CHEMICAL PAPERS.

1. "Measurement of the Internal Forces of Seeds."
   By Charles A. Shull.
2. "Heating Values of Natural Gases of the Midcontinental Field."
   By H. C. Allen.
3. "Corn Oil."
   By L. E. Sayre.
4. "Municipal Illumination."
   By J. A. G. Shirk.
5. "A Study of the Gelatinizing Agents, Pasty Materials and Thickeners Used in Food Products."
   By Leon A. Congdon.
6. "The Loss of Nitrogen and Organic Matter in Cultivated Kansas Soils."
   By C. O. Swanson.
7. "The Determination of Sulphates in Water."
   By F. W. Bruckmiller.
8. "The Quantitative Separation of Quinine and Strychnine."
   By G. N. Watson.
9. "The Composition and Properties of the Yucca Plant."
   By O. A. Beath.
10. "Muscale Buttons."
    By L. E. Sayre and A. E. Stevenson.
11. "Prunella vulgaris."
    By L. E. Sayre.
12. "Cultivation of Medicinal Plants in the United States."
    By L. E. Sayre.

MEASUREMENT OF THE INTERNAL FORCES OF SEEDS.

By Charles A. Shull

IT IS a well-known fact that when dry organic matter of any kind, as dry seeds, is brought into contact with water it imbibes moisture with great rapidity and swells with considerable energy. The water enters the swelling body in response to powerful internal forces which owe their existence and also their magnitude to the fact that the organic matter is composed of extremely minute particles which exhibit surface force. These forces, sometimes referred to as imbibition force, capillarity, surface force, etc., will be designated here simply as internal forces, since we have to deal with the resultant of a number of forces as expressed in the attraction of seed substance for water.

Furthermore, the universal presence of hygroscopic moisture in such organic matter is well known, and the fact that this moisture varies in quantity from day to day is a common observation. At all times the amount of water present in an air-dry seed, for instance, is determined by the balance between external forces which tend to remove water from the seed, and internal forces which resist this removal and which immediately cause moisture intake whenever they happen to exceed the external forces. In other words, moisture flows into or out of the seed as one set of forces or the other is the greater.

It must be noted, also, that the relation of these forces to water itself is such that as the water flows back and forth in response to given physical conditions, the greater force is always lessened by the movement of water, while the lesser force is simultaneously increased by that same movement of water, for instance, when the evaporating power of air is higher than the internal water-holding forces of the seed, the seed dries out. The moisture leaving the seed decreases the evaporating power of the air by increasing its vapor pressure, while the internal forces of the seed increase with surprising rapidity as the seed dries out, due to the thinning of the internal surface films. Again, if the surface force of a soil were

greater than the internal force of the seeds, moisture would pass from the seed to the soil, increasing the thickness of the surface films of the soil particles and thereby decreasing their surface attraction for water, while the internal forces of the seed increase as in the previous case. Finally, where the seed possesses a semipermeable coat, and lies in an osmotic solution whose pressure is greater than the internal forces of the seed, water is extracted from the seed, which dilutes the osmotic solution and lowers its force, while, as before, the internal force of the seed increases rapidly as it loses water. In each case the movement of water continues only until the two forces, unequal at the start, become equal. This establishes moisture equilibrium, and further movement of water must be consequent to some disturbance, either external or internal, of the balanced condition of the forces. It is because of this relationship of the forces to water itself that the seed under natural conditions never becomes absolutely dry. For as it approaches dryness, the internal forces of the seed far exceed the evaporating power of the driest natural atmosphere.

Few attempts have been made to measure the magnitude of the internal forces of the hydrogels that make up the seed. The measurement of forces which cause the entry of water into *absolutely dry* organic matter has been attempted, the values being calculated from the amount of heat released during imbibition. Such release of heat energy during imbibition was probably first observed by Pouillet. As early as 1865 Jungk suggested that the liberation of heat by finely divided bodies, on being wet, was due to a compression or condensation of the fluid by the surface force of the fine particles. Oven-dried starch, for instance, on being wet with water of the same temperature, often shows a rise of 10 to 12 degrees. It is estimated that a rise of .03° C. requires about 34 atmospheres of pressure, so that a rise of 11 degrees indicates a surface force far exceeding 10,000 atmospheres on the particles of absolutely dry starch.

Lagergren, in 1898, found that a gram of powdered charcoal having 4 meters of internal surface required about .224 g. of water to wet it, and that a little over 8 calories of heat was liberated by the wetting process. If a whole gram of water were to be used with as large a mass of charcoal as it could wet, the heat liberated from that one gram of water would be

about 36 calories. Basing his calculation on the known quantity of heat liberated by water on condensation by pressure, he estimates that this heat production would require at least 6150 atmospheres of pressure. Similar surface forces have been suggested for soils. Thus Mitscherlich, by using an ice calorimeter, has measured the heat of wetting in soils, and finds that the quantity of heat liberated varies with the physical character of the soil, the finer soils yielding larger amounts of free energy. Brown and Smith explain the fact that bacteria can continue the nitrification process in frozen soils by suggesting that these surface forces in soils may prevent the freezing of the water nearest the soil particle. They state that the force of surface condensation has been estimated at from 6000 to 25,000 atmospheres.

However, forces of such magnitude as these do not occur in ordinary air-dry seeds, for they already contain as hygroscopic moisture the water which would be taken up with such tremendous force if they were absolutely dry. But they do give us a clear idea of the power with which the seed retains the last part of its hygroscopic moisture, for this must be a force opposite and equal to that with which wetting occurs.

The discovery of perfectly semipermeable seed coats in barley by Brown in 1907, in wheat by Schröder in 1909, and in *Xanthium* by myself in 1912, laid open the way to measuring the ordinary internal forces of seeds by osmotic solutions. Such measurements were made by the writer a couple of years ago for the seeds of several species of *Xanthium*, using saturated lithium and sodium chloride solution, and more dilute solutions of the latter salt to provide the external forces. Seeds were placed in solutions of various concentrations, and allowed to come to moisture equilibrium, which was indicated by constancy in the weight of the seeds. The osmotic pressure, calculated by physical chemical methods, gave the external force, and therefore the equal internal force of the seeds when they had come to equilibrium with that strength of solution.

While the forces were by no means so large as those indicated for oven-dried matter, still they were found to be of considerable magnitude. In saturated solutions of sodium chloride the seeds were able to crystallize the salt out of solution by withdrawal of pure water from its hydration compounds. It was found that an air-dry seed of the cocklebur,

when its hygroscopic equilibrum was represented by 7 per cent of moisture, had an initial internal pressure of but little less than a thousand atmospheres (965), or more than 14,000 pounds per square inch. When the moisture content of the seed has been increased until it amounts to about 14 per cent of the absolute dry weight of the seed (about 7 per cent beyond the ordinary hygroscopic moisture) the internal force is a little less than 400 atmospheres at ordinary temperatures. And so the internal force could be determined for any particular moisture content.

The assumption is made that moisture equilibrium results from the interplay of forces which actually become equal when equilibrium is attained. In other words, I am assuming that the total osmotic pressure is transmitted as force when pitted against the internal force of the seed. While definite proof as to the validity of this assumption can not be offered at present, there is some supporting evidence, and unless or until it is shown to be erroneous it is believed to be justified.

Obviously, this method of measurement can be applied only to seeds which have perfectly semipermeable coats. But many seeds have permeable testas, or possess an open micropyle, which makes the application of such a method impossible. A new method of measuring the internal forces of seeds is now being perfected which can be applied to any seed regardless of the character of the coat. It is based on the assumption that osmotic pressure can be computed from vapor pressure—an assumption whose validity is admitted by practically all physicists and physical chemists—and that the vapor pressure of the seed hydrogels measured against the vapor pressure of strong solutions is a true measure of the internal force of the seed. Although not proven valid, this second assumption seems as reasonable as the first; and in actual practice the values obtained for the internal forces of the seed colloids by this method are fairly concordant with those obtained by the osmotic-pressure method.

This method consists of suspending the air-dry seeds in an enclosed atmosphere over a series of sulphuric acids of varying strengths from very dilute to the pure acid as obtained from the stock bottles, *i. e.*, acid of about 1.83 specific gravity. Over the dilute acids, where the vapor pressure is relatively high, the seeds imbibe moisture because their own vapor pressure

is lower. This imbibition continues until the vapor pressure of the seeds and that of the solution over which they lie are equal. This establishes equilibruim of forces, and no further change occurs. The higher the vapor pressure of the solution, the larger the amount of adjustment which occurs; and the lower the vapor pressure, the smaller the adjustment necessary for attainment of equilibrium relations.

Above the concentrated acids, where the vapor pressure of the solutions is low, the seeds lose moisture because their own vapor pressure is higher. They continue to lose moisture until the vapor pressure of the seeds is reduced to that of the solution below them, after which no change occurs, as the equilibrium is established at that point. The loss is greatest over the strongest acid, and is successively less as the vapor pressure increases by dilution.

Between these two extremes there is a point which is easily established where the seeds neither gain nor lose in moisture because the vapor pressure of the seed colloids and that of the solution are equal at the start.

Using the original weight of the seeds as a base line, and calling percentage of gain in weight positive, and percentage of loss in weight negative, a curve can be constructed, connecting the equilibrium points in the series. This curve cuts the base line at the point of natural equilibrium. In order to determine the original internal force of the seeds, all that is necessary now is to determine the osmotic pressure of the sulphuric acid over which seeds neither gained nor lost in weight.

This is done from the data by using the vapor-pressure formula for determining osmotic pressure given in all the physical chemistries, and securing the necessary values from the physical chemical tables of Landolt-Börnstein. In one such determination the internal force of an air-dry seed was found to be more than 900 atmospheres, which is not in serious disagreement with the values found by the osmotic-pressure method. A difference of one per cent in the hygroscopic moisture of the seeds with which the two tests mentioned were carried out would make much more than 100 atmospheres of difference in the internal force of the seed. Since the difference between the two tests is only about 50 atmospheres, a fraction of one per cent difference in the original moisture

content of the lots of seeds would account for the entire difference. The closeness of the agreement speaks strongly for the accuracy of the methods and for the validity of all assumptions involved in the mode of procedure.

The high values found for the internal forces of the seed are significant in connection with the physiology of the seeds of agricultural plants. It has been observed, as, for instance, in Bulletin No. 23, Bureau of Soils, that seeds can secure much moisture from soils which contain only a small amount of water. A loam soil holding 15 per cent of moisture yielded it to air-dry beans so freely that at the end of twelve hours the beans had taken up 60 per cent of their weight of water. A very striking experiment consisted in mixing 50 grams of air-dry cowpeas, whose hygroscopic moisture was about 14 per cent, with 50 grams of soil which contained 15 per cent of water. In twelve hours the cowpeas took up 12.1 per cent of their weight of water, leaving only 1.3 per cent in the soil. That is, the soil was nearly air dry. The very high values found for the internal forces of air-dry seeds gives us a satisfactory explanation of this power of seeds to absorb large amounts of moisture from relatively dry soils, and of their ability to secure enough water for germination under such conditions.

While the seed, by virtue of its powerful internal forces, can secure water for germination, those forces are fully satisfied and disappear with saturation. As soon as the young seedling begins to establish itself it is left wholly dependent on other much weaker forces for securing its water supply. The seed is admirably adapted to bring about conditions under which these new forces become effective in the life of the plant.

HEATING VALUES OF NATURAL GASES OF THE MIDCONTINENTAL FIELD.

By H. C. Allen.

WHILE a number of new gas pools hove been opened up in the midcontinental field in the last few years, no particular work of a chemical nature has been done on any of these gases since the work of Cady and McFarland.[1] Results of a preliminary examination of a number of these new gases are given in the following, together with some analyses of gases from the older pools of the field.

The thing of practical importance to the ordinary consumer of natural gas is its heating power, and these gases are of great interest in this line from the fact that they vary over such a wide range. This is illustrated in the following table:

Table I.

No.	Location. (Sec., twp., range.)	CO_2.	HHC.	O_2.	CH_4.	C_2H_6.	Res.	B.t.u.
1*	Augusta, Kan. (500 feet)	0.13	0.00	0.00	10.54	1.64	87.69	129
2	Cowley county, Kan. (24-33-6)	0.13	0.00	0.37	16.27	3.01	80.23	209
3	Chautauqua county, Kan. (35-33-10)	0.30	0.00	0.18	42.38	1.85	55.29	441
4	Chautauqua county, Kan. (25-33-10)	0.00	0.00	0.40	49.01	3.89	46.67	541
5*	Ellsworth, Kan	0.30	0.23	0.09	61.09	1.09	37.20	609
6*	Ponca City, Okla. (4-25-2E)	0.05	0.00	0.40	14.60	14.86	40.10	688
7	Kay county, Okla.	0.21	0.32	0.00	57.91	9.89	31.65	735
8*	Chautauqua county, Kan. (15-34-13)	0.55	0.00	0.81	85.53	0.15	12.95	839
9*	Chautauqua county, Kan. (15-34-13)	0.11	0.59	0.98	79.13	7.79	11.39	894
10	Butler county, Kan. (2-28-4)	0.00	0.71	0.14	62.15	18.38	18.64	930
11	Montgomery county, Kan.	0.21	0.24	0.25	83.04	8.54	7.95	970
12	Blackwell, Okla. (13-28-1W)	0.00	1.18	0.16	70.69	18.65	9.32	1025
13	Cushing, Okla. (28-18-7)	tr.	0.12	tr.	70.74	21.64	7.49	1059
14	Bartlesville, Okla. (12-26-14)	0.24	1.21	0.24	70.50	24.60	3.21	1125

All B.t.u. above are calculated to 0° C. and 760 mm. pressure from the following values: Heavy hydrocarbons (HHC), 1627; CH_4, 966; C_2H_6, 1728.

* Analyzed by Mr. E. E. Lyder. No. 8 from 530 feet of sand; No. 9 from 580 feet of sand.

1. University of Kansas Geol. Survey, vol. 9.

So far as the writer is aware, such a wide variation in composition and heating value is not found in the other natural-gas fields, and it has been a rather common practice to consider natural gases, with a few unimportant exceptions, to be of about the same composition and heating value.

The economic problem involved in the sale of these gases is a very material one, since some of these gases of low heating value are found in considerable quantities and the lower ones are practically valueless as fuels. While no effort is being made to sell the gas from the shallow Augusta or Dexter fields, gases of all the other grades listed above are being sold. The loss to the consumer in heat units, and consequently in money, from the use of a 500 B. t. u. gas amounts to 50 per cent when compared to the present gas supplied to Lawrence as a standard.

The following are typical analyses of gas from wells located in various parts of the midcontinental field:

TABLE II. *Oklahoma.*

LOCATION. (Sec., twp., range.)	No. of samples.	CO_2.	HHC.	O_2.	CH_4.	C_2H_6.	Res.	B.t.u.
Pawhuska (3-25-9)	3	0.77	0.15	0.62	90.9	5.4	2.4	971
Cushing, (28-18-7)	5	tr.	0.12	tr.	70.74	21.64	7.49	1059
Cushing, (6-18-7)	2	0.83	0.12	0.42	67.26	18.96	12.14	984
Bigheart, (Lot 298)	3	0.86	0.15	0.30	78.90	16.43	3.34	1048
Hominy creek, (11-22-10)	2	0.16	0.46	1.07	79.09	11.47	7.76	970
Hominy, (9-23-8)	2	tr.	0.00	tr.	75.65	8.69	15.52	881
Bartlesville, (12-26-14)	7	0.13	1.03	0.39	72.02	21.16	5.29	1078
Hogshooter, (30-26-15)	5	0.14	0.83	0.10	73.07	20.63	5.23	1075
Hogshooter, (33-26-14)	2	1.55	0.09	0.39	91.82	2.35	3.98	927
North Osage, (2-28-10)	8	0.40	0.80	0.54	72.64	13.62	11.88	950
Wann, (34-28-14)	1	0.48	0.49	0.32	76.66	16.26	5.80	1029
Wagner county, (6-19-15)	1	1.60	1.53	0.36	69.01	17.31	10.17	991
Blackwell, (24-28-1W)	11	0.00	0.32	0.47	71.40	20.13	7.76	1043
Blackwell,* (16-29-1E)	1	0.05	0.10	0.11	60.54	6.22	32.97	690
Ponca,* (9-27-3E)	5	1.00	0.23	0.00	84.16	7.53	7.08	947
Ponca,* (4-25-2E)	1	0.05	0.00	0.40	44.60	14.86	40.10	688

* Analyses by Mr. E. E. Lyder.

TABLE III. *Kansas.*

LOCATION. (Sec., twp., range.)	No. of samples.	CO_2.	HHC.	O_2.	CH_4.	C_2H_6.	Res.	B.t.u.
Augusta, (*a*)	10							
Sedan, (*b*)	13							
Sedan, (*c*)	6							
Arkansas City,* (15-35-2)	2	0.00	0.38	0.10	67.36	14.68	17.46	908
Arkansas City,* (18-34-4)	1	0.00	0.43	0.00	73.28	17.10	9.18	1006
Allen county, (9-26-20)	1	0.35	1.15	0.39	79.80	4.33	14.00	865
Winfield,* (12-33-4)	5	0.36	0.00	0.24	77.90	9.51	11.98	912
Havana	2	0.00	0.45	0.20	72.56	13.46	13.34	955
Benedict, (16-28-15)	1	0.12	0.00	0.46	92.30		4.30	900

* Analyses by Mr. E. E. Lyder.
(*a*) See Table I, No. 1, for 1100 feet of gas. (*b*) See Table I, No. 4. (*c*) See Table I, No. 3.

TABLE IV. *City Supplies.*

CITY.	Date.	CO_2.	HHC.	O_2.	CH_4.	C_2H_6.	Res.	B.t.u.
Lawrence, Kan	Aug. 19, 1913	0.00	0.23	0.35	88.18	4.90	6.12	941
Lawrence, Kan.	Jan. 9, 1914	0.62	0.62	0.17	82.38	9.92	6.22	977
Lawrence, Kan	Feb. 23, 1914	0.72	0.57	tr	86.42	7.23	5.06	969
Lawrence, Kan.	Nov. 24, 1914	1.28	1.55	0.93	79.00	7.28	10.00	913
Lawrence, Kan	Jan. 15, 1915	0.71	0.21	0.08	85.77	7.97	5.25	970
Lawrence, Kan.*	Mar. 14, 1915	0.79	0.13	0.35	81.75	11.14	5.82	979
Lawrence, Kan.*	Apr. 15, 1915	0.13	0.54	0.29	88.30	6.82	3.82	975
Udall, Kan	Dec. 18, 1913	0.27	0.37	0.41	63.00	5.67	30.35	713
Udall, Kan	Feb. 18, 1914	0.00	0.00	0.38	73.39	17.73	8.51	1015
Wellington, Kan	Dec. 18, 1913	0.20	0.12	0.36	65.18	10.20	23.96	808
Wellington, Kan	Feb. 18, 1914	0.00	0.60	0.31	75.53	15.42	8.15	1005
Winfield, Kan.	Feb. 18, 1914	0.00	0.47	0.63	73.82	16.87	8.21	1013
Burden, Kan	Feb. 18, 1914	0.93	0.00	0.31	79.26	10.33	9.17	944
Augusta, Kan	Feb. 21, 1914	0.00	1.01	tr	75.68	10.97	12.33	956
Ottawa, Kan	Feb. 21, 1915	0.40	0.53	0.54	88.93	4.68	4.93	948
Wichita, Kan	Dec. 18, 1913	0.27	0.76	0.22	59.88	15.69	23.13	862
Wichita, Kan	Feb. 10, 1914	0.36	0.72	0.24	61.71	17.66	16.28	942
Hutchinson, Kan	Feb. 10, 1914	0.46	0.70	0.23	66.20	17.24	15.17	949
Arkansas City, Kan	Dec. 18, 1913	0.16	0.17	0.20	52.06	33.42	15.10	1066
El Dorado, Kan	Dec. 8, 1913	0.53	0.00	0.59	45.70	30.81	22.19	974
Fort Worth, Tex.	Jan. 25 1914	0.00	0.63	tr	46.10	13.96	39.01	700
Dallas, Tex.	Jan. 24, 1914	0.00	0.51	0.25	40.92	17.96	40.37	714

*Analyses by Mr. E. E. Lyder.

The above work is preliminary, in a way, to a general survey of the midcontinental field that is being made by the University of Kansas, and which is to be published later.

CORN OIL.

By L. E. Sayre.

LAST year the writer had the opportunity of reading a paper before the Academy on "Corn Oil as a By-product from Cereal Manufacture." Emphasis was laid upon its comparative cheapness, and the paper showed that corn oil could be used advantageously as a substitute for olive and cottonseed oils in the making of medicinal preparations. A report was made at that time on the physical properties of the oil, the saponification number, iodine number, and certain other characteristics as to solubility, congealing point, refractive index, etc. The medicinal preparations resulting from its use in making of liniments, plasters, cerates, oleates, etc., were mentioned. In most every case where corn oil was substituted for either cottonseed or olive oil a product resulted which was equal, if not superior, in most particulars to those made from either olive or cottonseed oil.

During the past year an effort has been made to produce a hardened product which would result by the process of hydrogenation. This process consists of the use of a suitable catalyzer; for example, a freshly precipitated nickel oxide is reduced, by passing a current of hydrogen through it, to a metallic state. This is carried on at a temperature of 360° C. The finely divided metallic nickel constitutes the catalyzer in question. The nickel reduced as above is dried in an atmosphere of hydrogen and is brought in contact with the oil to be hydrogenated, care being taken that it shall not come in contact with the action of the acid during the process. The mixture of oil and nickel is then brought in close contact with hydrogen through a tall cylindrical tank, and in still closer contact by an adjustment to the apparatus which causes the mixture of oil, catalyzer and hydrogen to flow through a narrow tube, the whole being kept at a temperature of from 175° to 190° C. The pressure is maintained in hydrogenation from one atmosphere, or less, to 25 pounds. Any excessive pressure is liable to leakage of hydrogen, which is difficult to keep from issuing through the tightest of vessels. The pressure used is regulated for different oils, some requiring more than others

for proper hydrogenation. After the hydrogenation is effected the mixture is pumped into a tank, heated by steam, then conducted to a filter press, where the catalyzer is removed by filtration and the oil permitted to harden. I present here a specimen of the hydrogenated corn oil, made from one pint of corn oil. This product was kindly prepared for me especially, from authentic material (furnished by myself) by Procter & Gamble. The fusing point of the product is between 63° and 65° C. Comparing this with the fusing points of other fats, I would say that prepared suet has a fusing point of 45° to 50°, spermaceti from 50.5° to 53.5° C., and beeswax from 62° to 64° C. It has a comparatively tough structure, but by no means as tough as that of wax; much more so, however, than spermaceti. The odor, if it has any, is rather agreeable.

Experiments will be performed in the future as to the utility of this product in various applications.

We now have a student, Mr. Donald H. Lackey, working on the problem of hydrogenation. Mr. Lackey, in his work, will construct an apparatus for the purpose of the hydrogenation of oils, to be used in laboratory experimentation.

It may be said that hydrogenated corn oil, when suitably prepared, is a product which has the faculty of improving cottonseed oil, or similar hydrogenated oils, which tend to granulate.

The process of hydrogenation has become of such general interest to the various industries that numerous patents have been taken out for the process. Attention should be called, in this connection, to a valuable publication of recent date, the title of which is "The Hydrogenation of Oils, Catalysis, Catalyzers and the Generation of Hydrogen," by Carleton Ellis, published by D. Van Ostrand Company.

Experiments as to the drying quality of corn oil prove the following:

DRYING TESTS.

Lindseed oil	film dries on glass in 3 days.
Corn oil and lindseed oil, equal parts	film dries on glass in 7 days.
Corn oil, pure	film dries on glass in 14 days.

At the end of 14 days corn oil leaves a rather dry, not hard, film, rather fatty in character.

NOTE.—In a recent issue of the *Journal of Industrial Engineering Chemistry*, in an article on the hydrogenation of various oils it is shown that the degree of hydrogenization modifies, as one would expect, the consistency and fusing point of the product.

MUNICIPAL ILLUMINATION.

By J. A. G. Shirk.

BEFORE the days of systematic street lighting only those ventured out at night who had urgent business or ample bodyguard. The committing of crime under cover of darkness was what drove our grandfathers to devise their crude systems of street illumination. City streets have become safe just to the extent that they have become well lighted. It is true that light alone would be insufficient protection, but it is equally true that police alone, in reasonable numbers, can not afford complete protection. A city in these days can certainly afford, and the citizens reasonably expect, to have the fullest possible degree of protection every hour of the day. Thus the first reason for instituting street lights is still one of the main factors in determining the nature and amount of municipal illumination.

Closely associated with the *reduction of the amount of crime* is the *prevention of accidents* to those who use our walks and streets at night. We all know how a small object on the walk, or some defect in it, may become a menace to our safety when there is insufficient illumination. Vehicles which travel rapidly carry their own special means of lighting the road, but it is unnecessary that pedestrians carry with them a lantern as in the earlier days of our national history. And all cities are striving to make the passage of their walks more convenient and pleasant, as well as safe, by introducing a well-distributed system of illumination.

For this purpose to-day there is nothing superior in point of cost and service to the new nitrogen-filled tungsten lamps installed on pole brackets with good reflectors. These lamps have the short, rugged filament characteristic of all series lamps, and have an efficiency of about .6 watt per candle-power, in comparison with the form still used in many installations of the longer and finer filament of the multiple lamps, giving only about half as much light for the same amount of electrical energy consumed.

In some cities there is still in use the old, glaring arc lamps placed at the street intersections, and often, on account of

their expense of operation, only installed at alternate corners. This means that if there are many trees, the walks especially are very poorly lighted midway in the block. These lamps consume about 450 watts, and are generally rated as 800 to 1000 candlepower. For the same number of watts of electrical power used we might install seven or eight 80 c. p. nitrogen-filled lamps, thus making from three to four lights per block; or if they were distributed along the cross streets as well, one at each intersection and one at the middle of each block. This would give a uniform illumination of sufficient intensity for the smaller city or town where crime prevention is not the main consideration. The cost of maintenance of these lamps averages about $10 per year each, while the arc lamps average $75 per year. These are the prices for both electricity and lamp maintenance. Thus it will be seen that the seven or eight distributed units do not cost more than the one arc lamp. Many cities are tied to the use of arcs for ten to fifteen years yet, on account of the customary twenty-year franchises which are given for the service. There is an enormous amount of money invested in the thousands of arc lamps now installed, and the change to the distributed series tungsten lamps is generally made only at the expiration of franchises.

Besides these reasons for the illumination of our streets and alleys, there is the problem of rendering certain streets attractive, especially the main business streets. The problem of efficient and economical street lighting is of great importance to those actively interested in improving the appearance of any city. The progressive merchant is fully aware of the value of artistic lighting and of its effect on the volume of trade, and it has been demonstrated repeatedly that many advantages are gained by the city having a distinctive decorative street illumination system.

Generally speaking, the value of property on a business street is directly proportionate to the number of people who make use of the street as a thoroughfare. A corner lot on the main business street is worth more than a lot in the latest addition to the city, simply and solely because a greater number of people pass that corner every day. It not infrequently happens that opposite sides of a street on the same block have considerably different values, due to the same cause. Anything which adds to the traffic of the street must, therefore,

add to the value of the abutting property. While conditions of accessibility to necessary utilities, such as railway stations, hotels, banks, public buildings, etc., have doubtless a preponderating influence in determining the traffic of a street, it is equally true that no subsidiary condition has such a vital effect as the lighting. It would, of course, be absurd to expect to create a popular business street out of a thoroughfare lying far beyond the natural limits of traffic, but there is no question that any street directly tributary to a business thoroughfare can be fully doubled in value by the installation of spectacular lighting.

In a more general way, lighting the entire business section of a city up to the standards of modern illumination does for the city, as a whole, what the lighting of a particular street does for that section; it increases values by increasing the traffic, not only from the city itself, but from the surrounding country and near-by towns. Good street lighting, more than anything else, gives to the city an air of progressiveness and prosperity. "Nothing succeeds like success"; to appear prosperous is the first step to being prosperous. Anything which adds to the general attractiveness of a city excites interest in its affairs and fosters public spirit and civic pride. Every citizen should be able to point with pride to his own city; but how shall he do this when he sees such woeful deficiency as poor public lighting?

The merchants of a city feel the competition of other cities with good lighting systems, and are generally the ones directly responsible for the promotion of a scheme of ornamental illumination. If they be so fortunate as to have an electric-light company managed by a far-sighted and progressive superintendent, the problem of securing an excellent system at a reasonable cost is greatly simplified. Pittsburg, Kan., had just such a combination of progressive men in their Chamber of Commerce, and gradually a plan was evolved which was larger and finer than its first promoters had fondly dreamed of. At first it was proposed to install a multiple lighting system, using the ordinary 110-volt tungsten lamps, but when the writer brought it to the attention of the engineer and commissioners that a new nitrogen-filled series tungsten lamp had just been placed on the market, which would give double the amount of light, it was decided to abandon the original plan

and substitute for it a modern series system. Such a system was finally completed and formally opened Friday night, October 21, 1914. Eight poles per block were installed, each carrying four lamp brackets. The poles are made of three different sizes of seamless steel tubing, welded together, and fitted with ornamental collars, base, brackets and cross-arms. They are set six feet in the ground and are surrounded by concrete 2 ft. by 1½ ft., in section, with the 2-foot side parallel to the curb. This heavy base was necessary, as the poles were also used to support the trolley wires for the street-railway system. In return for the privilege of attaching the trolley wires to these poles, the street-car company assisted in the erection of the poles. Fourteen-inch inverted balls are used, with their centers 13 ft. 6 in. above the sidewalk grade. A large number of different makes were tested to secure the best one available, considering cost, absorption of light, strength, and hiding of the filament of the lamp. The Carrara (Dense) globe, made by the Glieson Tiebout Glass Company, of Brooklyn, was selected as meeting best all the conditions. Its apparent absorption was approximately 15 per cent, its weight 5¼ pounds, and it almost completely hid the lamp, thus giving out a beautiful soft glow. We believe it will take a severe hail storm to injure these globes, since they are unusually heavy for the amount of light absorbed.

Three lamps are switched off at eleven o'clock, while the one over the street is operated all night. No moonlight schedule is followed, the lamps being operated every night.

The three smaller ones are the standard 80 c. p. nitrogen-filled series tungsten, using approximately 56 watts, and the larger one is a special 100-watt, 140 c. p. lamp of the same type. These lamps cost about 88 cents and $1, respectively. The wires are carried overhead in two series circuits, using No. 8 weatherproof wire. This was furnished and installed by the electric-light company. The wires inside the pole are 10,000-volt No. 6 solid standard wire, and enter the pole through moisture-proof bushings. One hundred and seventy-three poles were installed at an average cost of $81 per pole. This was paid by a tax on adjacent property in a similar manner to a paving tax. The city pays for the electric current and maintenance of the system. The electric company made the very moderate rate of $14 per pole per year for the

current and lamp renewals. This will give them a rate of about 2 cents per kilowatt hour. This is a low price, but the company looks on the new white way as one of its best advertisements, and electric light and power have become more popular since this fine system has been installed.

The close proximity of the lamp posts, averaging less than 95 feet, makes the illumination very uniform, and the soft glow of the globes renders an effect more pleasing than the great majority of such systems. It is justly a civic improvement to which every citizen of Pittsburg may point with pride.

A STUDY OF THE GELATINIZING AGENTS, PASTY MATERIALS AND THICKENERS USED IN FOOD PRODUCTS.

By Léon A. Congdon.

THE use of gelatinizing agents, pasty materials and thickeners in food products has become quite prevalent in recent years. Hence a study of these materials and their detection in food products is important to the chemist. Quite often thickeners, pasty materials and gelatinizing agents are used to cheapen the genuine articles, in that they are used to represent the genuine articles. In this class might be mentioned agar-agar, which has been found in imitation lemon slices; starch, agar-agar and gelatine in imitation jelly; dextrin in imitation cocoa cubes; then again these materials are used to cover up inferiority. In this class might be mentioned albumen, or white of egg, which is sometimes used to glaze coffee beans to make them appear better than they really are. Again, the thickenings, etc., are used in such products as ice cream and custards, primarily to add bulk to the product, and to give the material in which they are used a frothy appearance. They are also used in this connection to make the ice cream and custards "stand up." A great many ice-cream manufacturers use a so-called "ice-cream powder." These "ice-cream powders" vary in composition, but generally contain one or combinations of the following: dextrin, acacia, tragacanth, gelatine, albumen, and starch.

This paper will deal more specifically with the detection of these gelatinizing agents, pasty materials, and thickeners. I will describe briefly the more common ones now in use.

Gelatine is usually regarded as an albuminoid, but does not come strictly within the requirements of the definition of simple proteins, which possess essentially the same chemical structure as the other proteins, but are characterized by great insolubility in all neutral solvents. Gelatine is prepared from bones and other animal parts, and is insoluble in cold water, but soluble in hot water. When the hot-water solution containing one per cent or more of gelatine cools it forms a jelly.

By prolonged boiling the gelatinizing power is lost. A solution of gelatine placed in the polariscope shows strongly lævorotary.

Starch belongs to the cellulose groups of carbohydrates. Carbohydrates are generally understood as being compounds of carbon, hydrogen, and oxygen, the last two elements being present in the proportion in which they occur in water. The cellulose groups ($C_6H_{10}O_5$) include starch, cellulose, dextrin, gums, etc. Pure starch is a glistening, white, granular powder having a peculiar feeling when rubbed between the thumb and finger. It is very hygroscopic, commercial starch containing about 18 per cent of moisture. Starch is very widely distributed in the vegetable kingdom, occurring in almost every plant at some stage in its growth. Starch is insoluble in cold water, alcohol, and ether; it is soluble in hot water, though not without a change. By boiling with dilute acids, starch is first converted by hydrolysis into a mixture of dextrin and maltose, and finally by prolonged boiling into dextrose. Malt extract also hydrolyzes starch in solution. Though the cereal and vegetable starches, whatever their origin, are identical chemically, the various starch granules have certain characteristics when viewed under the miscroscope that render their identification easy in most cases. The common starches used in commercial food products as pasty materials are wheat, corn, potato, rice, tapioca, buckwheat, barley, rye, etc.

Agar-agar is an important commercial gelatinizing agent. It has an entirely different composition than gelatine. "Agar-agar" is the East-Indian name for seaweed. It is soluble in hot water to a viscid, tasteless, odorless jelly. It is very similar to pectin, but usually considered as gelose (para-arabin—$C_6H_{10}O_5$). It is thus a carbohydrate. Agar-agar is known by various names, such as Japan agar; Japan, Bengal, Ceylon or Chinese isinglass. True agar-agar is an algæ, a species of seaweed. It is found principally in the Pacific and Indian oceans, and Japan sea.

Gum tragacanth, an important thickener, is used in such products as ice-cream powders. There are various uses for tragacanth in pharmacy. Gum tragacanth is the gummy exudation from *Astragulus gummifer.* Its habitat is Asia Minor, Syria, and Persia. The derivation of the word is from the Greek "tragos" (goat) and "akantha" (thorn, or horn); that is, the exuded gum acquires a horny consistency and appear-

ance; or the plant is thorny and the edges of it resist the attack of goats. Gum tragacanth is usually found on the market in whitish ribbon-shaped bands, with thorny consistency, and translucent. With fifty parts of water it swells up and forms a cloudy, gelatinous mass. It is principally cellulose, soluble gum, and bassorin acid.

Dextrin is simply starch heated to 250 C. There are three different kinds of dextrin, which give different chemical color reactions than starch with iodine solution — amylodextrin, erythrodextrin, and achroödextrin. The dextrin principally found in commerce is amylodextrin. Dextrin may also be made from starch by heating starch with dilute mineral acids, or diastase. It is a whitish powder, soluble in water. Dextrin has been known to be used as a constituent of certain ice-cream powders. It is sometimes substituted for acacia.

Gum arabic or acacia is the gummy exudation from *Acacia senegal.* Its habitat is East and West Africa, Arabia, Senegal, Kordofan, Egypt, India, and Nubia. The name comes from the Greek "akakia," a thorny Egyptian tree, and "ake," meaning a point. It is soluble in two parts water, but insoluble in alcohol. Its principal chemical constituents are arabin (arabic acid; gummic acid—$C_{12}H_{22}O_{11}$, or $C_{10}H_{18}O_2$) and para-arabin, usually in the form of calcium, magnesium and potassium arabates.

Albumen. There are two commercial kinds of albumen—the egg albumen, from white of eggs; and the blood albumen, from blood serum. Both are soluble in about eight parts of water. Albumen is a nitrogenous compound, and comes in the classification of the single proteins soluble in water and coagulable by heat. For the purpose of this paper, it is not necessary to go into the classification of the proteins.

Fruit or vegetable pectins. Very little is known about the pectin bodies of fruits and vegetables, but pectin is supposed to be a carbohydrate, similar in its properties to starch. Bracennont, who first investigated pectin, pointed out that he could obtain a gelatinizing agent from alkaline pectates which he isolated from carrots by treating the latter with alkalies. He accomplished this in 1825, and made jellies by dissolving these alkaline pectates in water, heating with sugar and then adding a small quantity of mineral acid. In 1909 and 1910, Goldwaite, by the methods of Chodnew and of

Fremy, obtained pectin from crabapple, grape, sweet-apple and peach juices, and from the white inner skins of oranges and lemons. The uncooked juices of apple, quince, lemon and orange, according to Goldwaite, did not contain pectin, but the uncooked fruit juices of currants and blackberries did contain pectin. It has long been known that the cooked fruit juices of apples, quinces, currants, blackberries, crabapples, grapes, plums, raspberries, peaches, barberries, cranberries, blueberries, pears, and, with care, cherries and stawberries, contain a substance which will form a jelly. Where the process of jelly making originated is not definitely known. The pectin, or the jellying principle, is still unsolved, but Bigelow, Parloa, Goldwaite and Leach have stated that in their opinion pectin is supposed to be a carbohydrate, similar in its properties to starch, while Herzfield regarded the pectin bodies as combinations of araban and galactan, and Tollens has suggested that they may be glucosides. All investigators have agreed, however, that the pectin is the gelatinizing agent. The principal theory is that pectose and pectase always exist in the unripe fruit, and when the fruit ripens the pectase acts upon the pectose, which is insoluble in water, converting it into pectin, which is soluble. Pectin is at its best when the fruit is just ripe or a little before. The French chemist Mangin divides the pectose groups into two series: (1) Neutral bodies which vary in their solubility in water. At one extreme we have the substance pectose, which is insoluble in water and closely associated with cellulose; at the other extreme the substance known as pectin, which is soluble in water but tends to form a jelly fairly readily. Intermediately between these are bodies of a gelatinous nature. (2) Substances allied to this group are feeble acids, the chief member of which occurs as calcium pectate; the latter forms a binding substance between the pores of many plants.

Decomposition of pectose bodies. Wienogradski and his pupils say it is due to anaërobic bacillus which will decompose pectin and calcium pectate, but has no action on cellulose. Flax is held together by an integument consisting of calcium pectate. This is gotten rid of by a fermentation process which decomposes the integument while leaving the fiber intact.

This important enzyme—pectose—which gelatinizes fruit juice containing pectin, plays an important part with calcium

salts, so it seems, and I am of the opinion that it throws some light on the jellying principle of fruit jellies. For instance, investigators have proved that fruit juices containing acid and pectin can be made into a jelly by heating, then adding sugar and heating again; likewise, fruit juices having considerable pectin and but little acid fail to jell, but if acid is added the substance forms a jelly. My theory is that when the acid is added to the calcium pectate, the calcium forms the salt of the added acid and frees the pectic acid; the pectic acid pectase clots the mass, and on cooling forms the jelly. When the fruit juice contains sufficient amount of acid in itself and no added acid is necessary, the action of the calcium pectate is with the fruit acid, etc. That pectin can be hydrolyzed by acids present if boiled sufficiently long has been proven by Goldwaite.

The following table, prepared and worked out by the writer on actual experiments in the laboratory, places the above-mentioned materials in six groups: Group I, the iodine solution group; Group II, the acid nitrate of mercury group; Group III, the concentrated solution of sodium borate group; Group IV, the solution of sodium hydrate group; Group V, the solution of mercuric chloride group, and Group VI, the solution of cuprammonia group.

A careful study of this group method shows that a new method for testing agar-agar has been discovered. This test is based on Groups II, III and IV, and the characteristic reactions for agar-agar depends on a new test for acacia in Group II, which is: the test with one drop of acid nitrate of mercury plus the unknown water solution yields a stringy gelatinous precipitate, *soluble in excess of the reagent.* Since the next group reagent, the concentrated solution of sodium borate, in Group III, only precipitates agar-agar and acacia, it is simply a test to prove whether one or both are present in the unknown water-soluble mixture. Going to Group IV, the solution of sodium hydrate group, this group reagent does not precipitate agar-agar, and hence if no precipitate is obtained agar-agar is absent, although if a white cloudy precipitate occurs the unknown is acacia, and if a brownish-yellow color occurs on heating the unknown is tragacanth. Acacia may be further tested for with a solution of soluble basic lead acetate, which gives a white gelatinous precipitate; and again tested for by

the acid nitrate of mercury test in Group II, as already indicated. The remaining tests in the other groups given in the table are rather well known, but the writer thinks that this group method will be helpful to those interested in food chemistry.

Group Reactions.

Groups.	*Group reagents.*	*Reactions with water-soluble solutions of the gelatinizing agents, pasty materials and thickeners.*
Group I.	Iodine solution.	Blue coloration indicates *starch*. (Sometimes green apples made into jelly will give traces of starch.)
		Purple coloration indicates *amylodextrin*.
		Red coloration indicates *erythrodextrin*.
		No coloration may indicate neither starch nor dextrin, but may be *achroödextrin*.
Group II.	Millon's or Stoke's reagent (acid nitrate of mercury).	Filtrate, after shaking substance in solution with reagent, is not clear, but cloudy. Filtrate picric acid solution—yellow precipitate indicates *gelatine*.
		Solution plus drop of this reagent yields a gelatinous precipitate, soluble in excess of this reagent, which indicates *acacia*.
		A slight white cloudy precipitate may indicate either *agar-agar* or *tragacanth* or both (test for *tragacanth* as in Group IV).
Group III.	Concentrated solution of sodium borate.	Yields a white gelatinous precipitate, which indicates either *agar-agar* or *acacia* or both.
		C. T. *Acacia* will give a gelatinous, opaque white precipitate with solution basic lead acetate.
		Acacia may be further tested for as in Group II or Group IV, or by adding a solution of tannin, which gives a bluish-black coloration.
Group IV.	Solution of sodium hydrate.	Yields brownish yellow color on heating, which indicates *tragacanth*.
		Yields a white cloudy precipitate, indicates *acacia*.
Group V.	Solution of mercuric chloride.	A slight turbidity may indicate *dextrin*.
		A white precipitate may indicate *albumen* and *gelatine*.
Group VI.	Schweitzer's reagent (solution of cuprammonia).	If a concentrated water solution of the unknown is treated with this reagent and placed on glass slide under microscope, a delicate framework of cupric pectate is evident, showing a *pectin* of fruit or vegetable origin present.

THE LOSS OF NITROGEN AND ORGANIC MATTER IN CULTIVATED KANSAS SOILS

And the Effect of this Loss on the Crop-producing Power of the Soil.

By C. O. Swanson.

THE decrease in the crop-producing power of the soil is a fact familiar to all students of agricultural problems. The larger productiveness of virgin soils as compared with the productiveness of these same soils after they have been under cultivation for several decades is well known by the men who broke up the virgin prairie and have continued to cultivate that soil for half a lifetime or more. If we make a study of the figures compiled by the State Board of Agriculture for the forty-year period, 1872-1911, we shall find that the leading crops show an average decrease in crop production. In Brown county the average corn production for the first twenty-year period, 1872-1891, was thirty-six bushels, and for the second twenty-year period, 1892-1911, was thirty bushels. Riley county produced an average of thirty-three bushels in the first period and twenty-five bushels in the second. In Sedgwick county the first period shows an average of thirty-two bushels and the second twenty-one bushels. "More live stock" is mentioned by some people as the panecea for this evil. If that by *itself* was the cure, then a typical live-stock county, where more grain is fed than raised, should not show this decrease in crop production. Butler is such a county. In the period between 1872 and 1891 the average corn production was thirty-two bushels per acre, and in the second period, 1892-1911, the average was twenty-six bushels. It is not necessary to give more figures to prove this fact. Any one who makes a study of the figures compiled by the State Board of Agriculture will find that there is an average decrease in crop production, and this is true in Butler, Greenwood and Chase, typical live-stock counties, as well as Brown, Sedgwick and Russell, where the type is called grain farming.

Seed adapted to climate and soil is an important factor in crop production. Seed improvement may not have made all the progress promoters of agriculture desire, but that the seed used by farmers in general is more adapted to the climate and

soil than the seed used thirty or forty years ago no student of agriculture will deny. Instruments of tillage have also been improved. The better the soil is cultivated, other things being equal, the greater its crop-producing power. In spite of these two factors which should have increased the average crop production per acre, we have a decrease.

The chemical department of the Agricultural Experiment Station has made a chemical analysis of about 250 samples of Kansas soil taken from thirteen different counties. These samples are analyzed for total nitrogen, phosphorus, potassium, calcium, organic and inorganic carbon. Studies in physiological botany have shown that plants also require iron, magnesium and sulphur from the soil. But agricultural experience as well as chemical analysis of soils have shown that soils are well supplied with these elements, and for that reason they are not included in our chemical analysis.

A study of the figures obtained in the chemical analysis of these Kansas soils shows that the elements nitrogen and carbon have disappeared from cultivated soils in proportionately larger quantities than the other essential elements. The opportunity for making this comparison does not always present itself. Generally a sample is taken to represent a soil type. If the field which best represents this type is in cultivation it may not be possible to get a sample of the same soil type from a native meadow or pasture. A few such opportunities have presented themselves, and the data obtained in the analysis of such samples form the basis of the discussion in this paper.

The soil sample is taken in three strata. Surface (0-7 inches), subsurface (7-20 inches), and subsoil (20-40 inches). Both nitrogen and carbon occur in a greater per cent in the surface stratum. They are a part of the organic matter or that portion of the soil which has come from decomposed plant substances. The carbon is assumed to constitute half of the organic matter. The ratio nitrogen to carbon is about 1 to 11. An acre of soil seven inches deep is assumed to weigh 2,000,000 pounds. If the percentage composition is known, the amount of any element per acre can be computed. The amount of carbon is multiplied by two to represent the organic matter.

In the accompanying table are given the pounds of nitrogen and organic matter per acre in the surface soil. These data

are obtained from figures published in Bulletin No. 199, Kansas Experiment Station, and from unpublished data on file in the department of chemistry. Data for samples of the same type, taken as close together as possible, have been selected for comparison. In several cases the sample of the cultivated soil and the uncultivated soil were taken only a few rods apart. In cases where no sample of the cultivated soil is directly comparable with the uncultivated soil on account of location and known history, the average of several cultivated soils is used. This makes a fair comparison.

It is true that occasionally a sample from a cultivated field shows a higher percentage of nitrogen and organic matter than a sample from the same type in a virgin field. Such cases are noticed in the report of the soils of Shawnee county, published as Bulletin No. 200, Kansas Experiment Station. In those cases the cultivated soil has received special care and the uncultivated soil represents a very poor phase of the type.

From the original data presented in Table I the figures in Table II are calculated. "The pounds loss of nitrogen" is the difference between the amount of nitrogen in the virgin soil and that in the cultivated soil. This difference varies from 1200 to 1500 pounds per acre. Soil sample 1032, from Greenwood county, was taken from a field which had been cultivated to corn for thirty years; the comparison sample of uncultivated soil was taken from a native meadow a few rods away. Sample 1034, Greenwood county, taken in a catalpa grove, shows a higher content of nitrogen and organic matter than any of the virgin soils, except soil sample 1052, taken in a native meadow in Brown county. This shows that, as far as this comparison goes, the soil in the catalpa grove shows no tendency towards depletion of nitrogen or organic matter. The sample of soil taken in a field cultivated to corn and forage crops, next to the catalpa grove, showed a nitrogen content of 3700 and organic matter to the extent of 89,200 pounds per acre in the surface soil, or a difference of 1500 pounds of nitrogen and 36,800 pounds of organic matter in favor of the soil in the catalpa grove.

What does it mean that an acre of land has lost 1200 pounds of nitrogen in surface soil? To produce one bushel of corn the soil must furnish one pound of nitrogen for the grain and one-half pound for the stalks and cobs. The 1200 pounds of nitro-

gen represents the amount needed to produce 800 bushels of corn, stalks and grain, or 26⅔ bushels per acre for thirty years, assuming that everything is removed from the land and that no nitrogen is lost in the drainage water. Such farming practice would be possible only with virgin soils well stocked with nitrogen and organic matter. Crops use a certain per cent of the nitrogen in the soil, and for that reason complete soil exhaustion is impossible. But soils are considered exhausted when the total amount of plant food possible for the crop to obtain is less than is required to produce a profitable crop. If a soil has been cultivated for thirty years to corn and has produced an average of twenty-six bushels per acre during this time, it will not be possible to produce this amount of corn in the next thirty years with the same method of farming practice. It is a common observation of farmers that it takes more work than formerly to produce crops. Cultivation is one of the means of producing usable plant food. In new soils that plant food which is most easily made usable is transformed first. When this has been used up the first flush of abundant crop production passes, and more work is required by the farmer.

In the third and fourth columns are shown the percentage losses of nitrogen and organic matter. The per cent loss of nitrogen varies from 22.6 per cent in the sample from Brown county to 43.5 per cent in the samples from Reno county. The next greatest losses are found in the samples from Butler and Greenwood counties, where according to the popular conception the farmers have the means of conserving soil fertility. Brown county shows the smallest loss, and in this part of the state proper systems of crop rotations have been used more. The per cent loss of organic matter varies from 23.3 in the Brown county samples to 51.3 in the Reno county samples. In every case the percentage loss of organic matter is greater than the percentage loss of nitrogen. These figures show that the cultivated soils of Kansas have lost on the average more than one-third of their original stock of organic matter. The seriousness of this situation can not be overemphasized. While these figures show the percentage of total loss, they do not tell anything about the quality of organic matter lost. This fact will be discussed later.

In the fifth column is found the per cent of nitrogen in organic matter. In every case the per cent of nitrogen is greater

in the cultivated soils than in the virgin soils. Chemically, carbon is the more active element. As organic matter becomes old it becomes more inert. The chemical changes are slower and the response of the soil is more sluggish.

Column 6 gives the ratio of nitrogen to carbon in organic matter. The widest ratio is found in virgin soils and the narrowest in the cultivated soils. The average of the native soils is 1:12 and that of the cultivated soils is 1:11.1. What is the significance of this ratio?

E. J. Russel states, in his book "Soil Conditions and Plant Growth," that the ratio between nitrogen and carbon in stubble is 1:40 and in legumes 1:25. Most of the organic matter in Kansas soils has come from the prairie grass. A number of samples of prairie hay analyzed at the chemical department of the Experiment Station have shown an average nitrogen content of 0.85 per cent. This is a very low nitrogen content, and would compare very well with the stubble to which Russel refers. As there are some native legumes, this would influence the ratio. An assumption that the ratio of nitrogen to carbon in the native vegetation was 1:36 would not be an unfair assumption. If the ratio of nitrogen to carbon in virgin soil is 1:12, it means that it would have taken three pounds of native vegetation for each pound of organic matter found in the soil, provided that there had been no loss of nitrogen in the process of transforming the native vegetation into such organic matter as is found in the soil. But it does not require any extensive study of the organic chemical changes which go on in the soil to know that great losses do occur.

This discussion is made for the purpose of showing the enormous amount of native vegetation it has taken to produce the organic matter in the soil, and in this discussion we leave out that present below the surface soil, and this in the aggregate would amount to about twice that in the surface soil. Most of the native prairie soils in Kansas contain over 100,000 pounds, or fifty tons, of organic matter in the surface soil of one acre seven inches deep. On the basis of the above discussion, which is based on chemical facts—and the estimate is less than what is known to actually take place—it has taken more than 150 tons of native vegetation to produce the organic matter found in our native prairie soils. If, then, over one-third of this organic matter has been lost from our soils after

less than fifty years of cultivation, it makes the thoughtful man stop and consider.

Organic matter is the life of the soil. Organic matter is of very little value in the soil unless it is undergoing chemical change. This chemical change can not take place without loss in the amount of organic matter. When organic matter decays it forms a number of substances, and many of these are indispensable for the proper functioning of the soil. It is these chemical changes which narrow the ratio between nitrogen and carbon and cause the consequent loss in the amount of organic matter. The loss of organic matter is not of itself an evil. Unless it does take place, the soil will not be fertile. In nature the raw materials for these transformations are supplied. The evil consequences follow when man upsets the order of nature and fails to supply the raw materials which are used up.

There are seven of nature's essentials for profitable crop production, namely: good seed, proper amount of light, suitable temperature, proper physical and biological conditions of the soil, an adequate amount of moisture, and plant food. The organic matter of the soil is directly connected with and influences all these conditions except seed and light.

The dark color of the soil is due to organic matter, and dark-colored soils warm up faster than those of lighter color. Soils well stocked with humus drain better, and well-drained soils are warmer than wet soils. The organic matter increases the water-holding capacity of sandy soils and prevents the sand from washing and blowing. The organic matter gives clay and silt soils a better structure, resulting in better tillage and drainage properties. Organic matter furnishes food for the countless microörganisms in the soils, and without these plant food can not be prepared. The chemical reactions directly associated with and due to organic matter is the greatest agency in the soil for making usable plant food from the materials stored up in the rock powder which makes up the great portion of the soil.

Farmers in many parts of the state are complaining of the development of gumbo spots in their fields. The majority of such spots observed by the writer are due to the loss of the original surface soil, either through soil-blowing or soil-washing. Where listing is done up and down the slopes it does not

take many years to remove the original surface soil. In the drier parts of the state blowing will accomplish the same result. The evil of soil-blowing increases with the disappearance of organic matter in the soil. The organic matter causes the fine soil particles to adhere together in larger aggregates, called soil grains, and these are not moved by the wind. When the organic matter is used up, these soil grains are reduced to dust which blows easily. Soil-washing does not take place where the soil is open so that the water is soaked up by the soil. Organic matter gives clay and silt soils an open structure, which enables the water to enter the soil, and besides it binds the fine clay particles together, so that they are less easily moved by water in motion.

Agricultural writers and speakers have a great deal to say about the evil of depleting soil fertility by the system of grain farming, and more live stock is urged as a remedy. As a matter of fact, one system is not to blame altogether, and the other system will not necessarily offer the remedy. If the farmers of Barton county deplete their soil fertility, and particularly organic matter, by exclusive wheat farming and straw burning, and the farmers of Butler county continually harvest forage crops from their cultivated fields and feed these forage crops as well as imported grain on the banks of a ravine, there is no difference between these systems as far as they affect soil fertility.

The ultimate purpose of farming is to produce substances which can be used for human food, clothing and shelter. Forestry rightly practiced does not deplete soil fertility. The cotton lint does not deplete the organic matter and soil fertility. The depletion is due to the removal of the cotton seed together with the rest of the plant. The amount of fertility removed in the animal carcass used as human food is comparatively small and can be easily restored. Four-fifths of the element phophorus, one of the limiting elements in soil fertility, goes into the bran and shorts when flour is manufactured for human food. The small amount removed in flour can easily be restored to the soil. Wheat farming depletes soil fertility because straw is burned or wasted and bran and shorts are exported. Because dairy farming exports only such substances as can be used directly as human food, it keeps up the organic matter of the soil better than many other systems of farming.

TABLE I.

Soil No.	County.	Soil type	Description.	Pounds of nitrogen per acre.	Pounds of organic matter per acre.
1021	Riley	Oswego silt loam	Native meadow	4,980	122,400
1023	Riley	Oswego silt loam	Continuous grain cropping about 30 years; wheat and corn	5,700	85,600
1052	Brown	Marshall silt loam	Native meadow	5,480	139,200
	Brown	Marshall silt loam	Average of six cultivated soils, the highest nitrogen 4560, and organic matter 111,600; rotation of corn, oats, clover and wheat	4,240	106,800
1037	Russell	Sedgwick clay loam	Native buffalo grass, in pasture	4,260	98,400
1036	Russell	Sedgwick clay loam	Continuous wheat growing for 30 years	2,960	64,400
1093	Allen	Oswego fine sandy loam	Native meadow	3,760	830600
1094	Allen	Oswego fine sandy loam	Cultivated; corn and broom corn	2,440	46,400
1127	Butler	Sedgwick clay loam	Native pasture	4,280	106,400
1128	Butler	Sedgwick clay loam	Cultivated; corn and forage crops	2,800	66'800
1031	Greenwood	Osage silty clay loam	Native meadow	4,600	113,600
1032	Greenwood	Osage silty clay loam	Corn 30 years	3,400	73,200
1249	Greenwood	Osage silty clay loam	Old timber land; 12 years in corn	4,800	112,400
1258	Greenwood	Osage silty clay loam	Corn and forage crops	3,600	76,400
1034	Greenwood	Summit silty clay loam	Catalpa grove	5,200	126,000
	Greenwood	Summit silty clay loam	Average of five cultivated samples, the highest nitrogen 4200, and organic matter 90,000; corn and forage crops,	3,400	76,400
1071	Reno	Reno loam	Native pasture	3,400	74,800
	Reno	Reno loam	Average of three cultivated soils, cultivated mostly to wheat	1,920	36,400

The discussion in this paper has shown that it has taken more than 150 tons of native vegetation to produce the organic matter in the surface soil. If we accept this very conservative assumption, and also know that one-third of the organic matter present in the virgin soils has been lost in less than fifty years of farming, it means that the least amount of organic matter necessary to return to the soil every year is one ton per acre in addition to what is now returned in stubble and cornstalks.

In addition to returning such substances as straw and farm manures, some substance must be added which restores the nitrogen removed in grain. A bushel of corn takes one pound of nitrogen, and a bushel of wheat one and one-third pounds. The best means of obtaining this nitrogen is by growing legumes such as alfalfa. But this nitrogen will not be restored to the soil if all the hay is exported from the farm. Some of the best agricultural investigators are of the opinion, based on scientific experimentation, that legumes, on the average, take only as much nitrogen from the air as is found in the hay. The growing of alfalfa, if grown for export, will not solve the problem of soil fertility any more than live-stock farming when the fertility is wasted on the banks of a ravine.

In all our discussions of problems of soil fertility we must not forget the peculiarity of the Kansas climate. We shall never be able to practice such a hand-to-mouth system as is possible in a climate of greater and more even rainfall. The soils must have a greater resistance against both excessive wet weather and dry weather. This resistance depends more on the content of organic matter than on any other factor. We have seen the enormous amount of native vegetation it has taken to produce this organic matter, and the very large loss in less than fifty years of farming. This enormous loss of organic matter is the most serious problem in soil fertility in the state of Kansas.

SUMMARY OF THIS PAPER.

1. The soils of Kansas show an average decrease in crop-producing power, in spite of the fact that farmers use seed which is better adapted to climate and soil, and improved methods of tillage.

2. Results based on chemical analysis of cultivated and uncultivated soils in seven representative counties show that the

elements carbon and nitrogen have disappeared from the cultivated soils to the largest extent. These cultivated soils have lost from 1200 to 1800 pounds of nitrogen and from 32,400 to to 49,600 pounds of organic matter per acre in the surface soil. On percentage basis, this amounts to from 22.6 to 43.5 per cent of the nitrogen, and from 23.3 to 51.3 per cent of the organic matter. It means that these soils have lost, in round numbers, from one-fifth to two-fifths of the nitrogen and from nearly one-fourth to one-half of the organic matter.

3. Decay of organic matter is the life of the soil. A comparison between the ratio of nitrogen and carbon in vegetable matter and in the organic matter of the soil shows the enormous amount of vegetable matter it has required to produce the organic matter in the soil. The loss of one-third of this organic matter, together with the accompanying nitrogen loss, is the most important cause of the decreased crop-producing power of the soil.

TABLE II.

County.	Kind of soil.	Pounds loss of nitrogen.	Pounds loss of organic matter.	Per cent loss of nitrogen.	Per cent loss of organic matter.	Per cent nitrogen in organic matter.	Ratio of nitrogen and carbon in organic matter
Riley	Native					4 07	1 : 12 2
Riley	Cultivated	1,280	36,800	25 7	30 7	4 32	1 : 11 6
Brown	Native					3 93	1 : 12 7
Brown	Cultivated	1,240	32,400	22 6	23 3	3 97	1 : 12 6
Russell	Native					4 33	1 : 11 5
Russell	Cultivated	1,300	31,000	30 5	34 5	4 60	1 : 10 7
Allen	Native					4 50	1 : 11 0
Allen	Cultivated	1,320	37,200	35 1	44 5	5 26	1 : 9 7
Butler	Native					4 02	1 : 12 7
Butler	Cultivated	1,480	39,600	34 5	37 2	4 19	1 : 11 9
Greenwood	Native					4 05	1 : 12 3
Greenwood	Cultivated	1,200	40,400	26.4	35 6	4 61	1 : 10 8
Greenwood	Native					4 27	1 : 11 7
Greenwood	Cultivated	1,200	36,000	25 0	32 0	4 71	1 : 10 6
Greenwood	Native					4 13	1 : 12 1
Greenwood	Cultivated	1,800	49,600	31 6	40 0	4 45	1 : 11 2
Reno	Native					4 55	1 : 11
Reno	Cultivated	1,480	38,400	43 5	51 3	5 28	1 : 9 5

THE DETERMINATION OF SULPHATES IN WATER.

The Use of Benzidine Hydrochloride.

By F. W. Bruckmiller.

THE majority of the waters of Kansas often contain considerable quantities of calcium sulphate, whose exact and quick determination is very often necessary. Especially is this true in the examination of boiler waters. The usual procedure for this determination is to precipitate the calcium sulphate as barium sulphate, filter, and weigh. This operation requires from four to twelve hours to complete, depending upon the quantity of calcium sulphate in the water. Where the content in calcium sulphate is desired to be known on short notice, therefore, this method will not meet the demand. The benzidine method, however, will, as the results herein contained show.

The method consists in precipitating the sulphates by means of benzidine hydrochloride—$C_{12}H_8(NH_2)_2 \cdot 2HCl$—as benzidine sulphate, which being insoluble in water is filtered off, suspended in water, and titrated in the hot with standard alkali, using phenolphthalein as indicator. This titration is possible by the very weak basic properties of benzidine. The whole operation can be completed in from fifteen to thirty minutes.

The method is not original with me, having been proposed by Raschig (Zeit. angew. Chem. 1903, 16:617) and investigated by Friedam and Nydegger (Zeit. angew. Chem. 1907, 19:9), whose suggestions I have followed and adapted and modified to suit water-analysis conditions.

After a few trial experiments the following method was decided upon as the best procedure for water analysis: To 250 cc. of water (less if the SO_4 content is greater than 500 parts per million) add 10 cc. of a 1 per cent solution of hydroxylamine hydrochloride (more if the iron content of the water is very high) and 20 cc. of benzidine hydrochloride. Stir vigorously and allow the silky white precipitate to settle. Filter on a disc of black ribbon filter paper in a Gooch crucible, *with suction.* Wash with cold distilled water twice (about 25 cc.), and drain precipitate thoroughly. Transfer the precipitate to the original beaker, add water, and heat to boiling. Titrate with N/20 NaOH, using phenolphthalein as the indicator. Parts per million $SO_4 = 9.6 \times$ cc. N/20 NaOH.

The benzidine hydrochloride solution is made up as follows: Place 8 grams of benzidine in an agate mortar, and add enough water to make a paste. Wash the paste into a one-liter flask, add 10 cc. concentrated HCl, and make up to the mark. Filter if necessary. 1 cc. = .0026 grams SO_4.

This method and the barium chloride method usually employed were used in the determination of sulphates on several hundred waters. The results by the two methods agreed very closely, as the data in the following table shows:

Comparison of results obtained with Barium Chloride and Benzidine.

Results expressed in parts per million.

Lab. No.	SO_4 by $BaCl_2$.	SO_4 by benzidine.	Difference.
6678	80.6	84.5	+3.9
6682	76.5	80.6	+4.1
6723	254.2	257.3	+3.1
6729	87.6	96.0	+8.4
6742	68.7	76.8	+8.1
6804	45.4	40.3	—5.1
6887	584.7	583.7	—1.0
6942	62.2	63.4	+1.2
7081	29.6	32.6	+3.0
7082	173.2	180.5	+7.3
7084	343.9	341.5	—2.4
7087	101.2	107.5	+6.3
7114	51.0	46.0	—5.0
7128	19.8	15.4	—4.4
7139	38.8	38.4	—0.4
7142	24.7	19.2	—5.5
7144	48.0	46.0	—2.0
7148	16.2	21.0	+4.8
7155	26.3	25.0	—1.3
7156	51.8	63.4	+1.6

Several precautions are necessary in order to obviate difficulty in carrying out the method. The precipitate should not be allowed to stand too long, for the silky precipitate turns to flakes on standing, which only dissolve after considerable boiling. The suction should be strong enough to remove the last traces of the mother liquid before any wash water is added. If it is not, too high results will be obtained.

After transferring the precipitate the water should be heated, preferably until all the precipitation is dissolved. Although this is not always necessary, it is sometimes a safe procedure to insure easier splitting off of the HCl groups.

THE QUANTITATIVE SEPARATION OF QUININE AND STRYCHNINE.

By G. N. Watson.

NO TWO DRUGS are more generally prescribed together than quinine and strychnine. They are found in such preparations as pills, syrups, tablets, powders, glycerites and elixirs. Owing to this fact their analysis becomes of importance to both the analyst and the toxicologist.

The dose of strychnine is very small, about one-sixtieth of a grain; the ordinary dose of quinine is comparatively large, two to five grains, the ratio of strychnine to quinine ranging from 1:30 to 1:120. It is this relatively small proportion of strychnine that renders the actual separation of these alkaloids one of the quite difficult problems confronting the pharmaceutical chemist.

Among the methods used by chemists to make this separation are: First, the ferrocyanide method; second, the oxalate method; and third, the tartrate method. The ferrocyanide method is based on the insolubility of strychnine ferrocyanide in strongly acid solution and the solubility of the quinine salt. The objection to the method is that the separation is not sharp. A small amount of quinine is carried down with the strychnine, giving a high apparent strychnine content.

The oxalate method is based on the relative insolubility of the oxalate of quinine and the solubility of the strychnine salt. The results by this method are generally too low for the strychnine content. Results 50 per cent lower than the actual strychnine content have been recorded.

The tartrate method, recommended by Vanderkleed, is carried out in a manner similar to the oxalate method. The quinine is precipitated as a tartrate and separated by filtration from the soluble strychnine tartrate. The tendency of this method is to give low results for strychnine.

Besides these gravimetric separation processes there are colorimetric methods for the determination of strychnine in the presence of quinine, among them being the color produced by strychnine in a sulphuric acid solution of potassium dichromate, and the color produced by oxidizing agents on

solutions of strychnine after treatment of the alkaloid with zinc and hydrochloric acid.

These methods are valuable as checks on gravimetric separation methods, but of course are of no value where a separation of the alkaloids is desired.

During the past few months I have been experimenting with a new method for the separation of these alkaloids, which in point of accuracy and simplicity seems to excel any method heretofore published. It is based on the comparative insolubility of strychnine chloroplatinate.

The chloroplatinate of strychnine is nearly insoluble in water, insoluble in alcohol, and practically insoluble in a mixture of alcohol 90 per cent and dilute hydrochloric acid 10 per cent. The chloroplatinate of quinine is soluble in water, fairly soluble in alcohol, and very readily soluble in the alcohol-hydrochloric acid mixture. It was from those facts that the following method was worked out.

Dissolve .050 grammes to .100 grammes of the mixed alkaloids (depending on amount of strychnine present) in a small amount of the alcohol-hydrochloric acid mixture (about 5 cc.) ; add 20 per cent solution of platinic chloride, drop by drop, while slightly agitating the mixture, until precipitation is complete. Add 5 cc. more of the solvent, cover with watch glass and set aside for one hour, then filter through tared filter, wash with alcohol, place in oven, dry at 100 C. for fifteen minutes, cool and weigh. If the proportion of quinine is large, it will be necessary to add 5 to 15 cc. more of the solvent before filtering. It will also be necessary to decompose the precipitate with alkali (NaOH), recover the strychnine with chloroform, evaporate and reprecipitate the chloroformic residue from a few cc. of the alcohol-hydrochloric acid solvent, with the platinic chloride reagent.

The chloroplatinate of strychnine is yellow in color, crystalline, and has a remarkable luster. It contains about 62 per cent of the alkaloid and 18 per cent of metallic platinum.

The chloroplatinate of quinine has an orange color and an amorphous appearance.

A trace of chloroplatinate of quinine gives an amorphous appearance to the chloroplatinate of strychnine—a valuable indication of the purity of the strychnine salt.

The amount of strychnine can be calculated from the weight

of the chloroplatinate, from the amount of metallic platinum, or directly by the decomposition of the chloroplatinate.

By this method it has been found possible to determine the strychnine in a mixture of .060 of quinine and .002 of strychnine, being about the proportions found in such preparations as elixir of iron, quinine and strychnine.

In determining the strychnine in the elixir of iron, quinine and strychnine, it would be necessary to liberate the total alkaloids and proceed with the mixed alkaloids as directed. The quinine can be determined by difference or from the filtrate by making alkaline, shaking out with ether or chloroform, and weighing the dried residue.

The only interfering alkaloid in this separation is brucine. Brucine, if present, would behave similarly to strychnine. Dionin, morphine, narcotine, codeine, heroin, atropine, colchicine, hydrastinine, narceine, coniine, cocaine, aconitine, scopolamine, physostigmine, pilocarpine, theobromine, cinchonine, antipyrine and caffeine are not precipitated from their acid alcoholic solutions. It is the rule, however, that most alkaloids are precipitated from their *alcoholic* solutions. The exceptions are dionin, atropine, colchicine, narceine, coniine, aconitine, theobromine, antipyrine, and caffeine. Dionin, colchicine, coniine, theobromine and caffeine are not precipitated from any of their solutions by the platinic chloride reagent.

THE COMPOSITION AND PROPERTIES OF THE YUCCA PLANT.

By O. A. Beath.

A SPECIES of yucca, botanically known as *Yucca angustifolia,* but more commonly called soap weed or Spanish bayonet, is found occurring abundantly on dry plains and hills from Nebraska to Montana, Texas and Arizona. Two other species are quite common—the *Yucca harrimaniæ,* found on the arid plains and hills of Utah and western Colorado, and the *Yucca baccata,* occurring from Colorado to Nevada, Texas and California.

In 1885 Abbott made the first chemical analysis of *Yucca angustifolia,* and in addition to the substances ordinarily reported present in plants closely related, found approximately six per cent of saponin. It is now known that the method used at that time gave high results, but, be that as it may, the fact that saponin was reported opened up a new field of investigation. Whether the saponin was toxic or not seems not to have been reported, but the conclusion was drawn that its presence in yucca was primarily for the purpose of rendering the insoluble soil constituents adaptable to the plant's growth and maintenance.

Several years ago it was reported that yucca contained an alkaloidal principle which was a specific for rheumatism when used internally. A careful investigation failed to produce positive results in this respect.

PROPERTIES AND USES OF SAPONINS.

Saponins, while not at all thoroughly understood, are at present used quite extensively. The saponins are mostly amorphous, colloidal substances which dissolve readily in water; their aqueous solutions, if shaken with oils, fats or resins, produce emulsions which are characterized by their great stability. Related with their emulsifying property is the employment of saponins as substitutes for soaps, although there is no evidence that yucca saponin is used for this purpose in the United States; yet it is true that in the East saponaceous soaps are preferred, since they have no deleterious effect on the color or the fiber of the most delicate fabrics.

Aqueous solutions of saponins have a marked power of retaining dissolved gases, as carbon dioxide; for this reason saponins are occasionally added to effervescent beverages, a use which is to be avoided in case the saponin is toxic.

PHYSIOLOGICAL ACTION.

The saponins are characterized by their strongly marked toxic properties. It is a well-established custom among fishermen to use saponins for killing fish. The fish so killed are not rendered unfit for human consumption.

By their powerful solvent action on the blood, saponins produce hæmolysis—a fact made use of in their identification.

PURPOSE OF INVESTIGATION.

Inasmuch as yucca is found abundantly in Kansas, especially so in the arid regions, it seemed advisable for the Department of the State Chemical Research of the University of Kansas to make a preliminary investigation of this plant, to answer, in a way, the numerous inquiries from over the state as to what use could be made of the plant commercially. The aim of the project was centered around the possibility of utilizing the saponin and fiber of the soap weed.

Without going into the details of the chemical analysis, which are found in the original report, the following summary will aid in holding in mind the general conclusions reached:

1. A method will have to be devised to obtain saponin directly. As it is at present, the percentage of saponin is estimated by measuring the hydrolytic products.

2. The maximum amount of saponin found in any part of the plant was two per cent—far too small an amount to profitably extract when the time of drying and expensive chemicals needed are considered.

3. After the plants are thoroughly dried, great care has to be exercised in preventing fermentation. Of course, on a small scale this factor can be easily avoided.

4. The fiber is much shorter than wood fiber; therefore a poor competitor, even though an inexpensive method could be devised for its preparation.

5. After the fiber has been dried it becomes brittle—a fact which is true of all vegetable fibers.

6. No chemical process has yet been found which will profitably separate the pith from the fiber without weakening the product.

7. It seems improbable that a method could be devised to strengthen the yucca fiber.

8. Fiber experts are of the opinion that a successful plan might be put into action whereby the fresh plants could be treated before they were air-dried. The aqueous extract obtained by the crushing could be developed, perhaps, for the saponin content.

MUSCALE BUTTONS.

By L. E. Sayre and A. E. Stevenson.

SOME TIME ago a missionary from one of the northern states sent to the writer a communication in which he referred to what was known as the "meschale eaters." The writer of the letter, whose name is purposely withheld, spoke of the product as a plant coming from Mexico, and stated that the effect of the plant was something like that of cocaine. The writer was asked to investigate the product and to determine what the article contained to produce such an effect.

A large sample of the article was finally obtained, which proved to be the muscale buttons. These grow in the arid hills along the Rio Grande and southward into Mexico. It is a small cactus (*Lophophora*), which is popularly known as "peyote." It is still used in ceremonies and for medicinal purposes by the Indian tribes between the Rocky Mountains and the Gulf of Mexico, from the Arkansas river southward. Among the white people the buttons are commonly known as "mescal," owing to a confusion with the maguey cactus of the southwest, from which latter the intoxicant known as mescal is prepared. The peyote plant resembles a radish in shape and size, and only the top appears above the ground. From the center springs a beautiful white blossom; the latter gives place to a top of white down. To the north of the Rio Grande this top alone is used, and when sliced and dried it forms the so-called button. In Mexico the whole plant is cut into slices, dried, and used as a decoction and in their ceremonies.

Mr. I. R. Geare has communicated a valuable contribution on this subject—"The Consumption of Peyote Among the Indians"—in the May issue of Merck's Reports, New York, 1913. In speaking of the ceremony he makes the following statement:

"The peyote ceremony is usually performed as an invocation for the recovery of the sick, and the chief feature of it among the Mexican Indians is a dance, while among the Kiowas, Comanches and other 'plains' tribes it is rather a ceremony of prayer and contemplation. The ceremony is held in a tipi especially erected for the purpose, and generally lasts all night. Women do not, as a rule, take part in the ceremony, but are occupied in preparing the sacred food as well as the feast, in which latter all join at the close of the ceremony. A fire is kept burning in the

center of the tipi, the men sitting around it. The fire is enclosed in a crescent-shaped mound, on the top of which is placed the sacred peyote. Following an opening prayer, each participant receives, chews and swallows four peyotes, after which the sacred songs begin, with accompaniment of drum and rattle. Each man, in turn, sings four songs, and the singing is kept up all night, varied by intervals of prayer and other distributions of peyote. At midnight a kind of a baptismal service takes place. The number of 'buttons' eaten by each individual during the night is from ten to forty or more. The drug produces a kind of spiritual exaltation, said to be different from that of any other drug, and without any reaction. During the ceremony the sick person to be prayed for is brought in, and he is allowed to eat one or more specially consecrated 'buttons.' When daylight comes the morning-star song is sung. The women then pass around the sacred food and the ceremony ends with the 'meat song.' After a season of friendly talk, followed by a dinner, the participants disperse."

In order to investigate the toxicity of the buttons, which were sent us as authentic material, 200 grammes of the powdered buttons were extracted by suitable solvents in order to remove all the physiological activity from the fibrous material. The solution thus obtained was purified repeatedly by the use of immiscible solvents, such as chloroform, ether, etc., until the solution was practically free from inert material and contained the active principles in the most concentrated form. Only a few milligrammes of the concentrated extractive were obtained from 200 grammes of the drug. Hence this was extremely concentrated.

The method of Heffter for separating the principles thus far isolated from the buttons is as follows:

The coarsely powdered drug is digested several times with 70 per cent alcohol. The alcohol is distilled from the united extracts, filtered to separate resinous material, then made alkaline with ammonia and shaken out with chloroform. The alkaloids are then extracted from the chloroform solution with diluted sulphuric acid, the alkaloid precipitated with ammonia, and the precipitated alkaloids treated with ether, which dissolved "anhalonin," "pellotin" and "lophophorin," while "meycalin," "anhalonidin" and "anhalamin" remain. The insoluble alkaloids are converted to sulphates and crystallized. The first crystallization product consists principally of meycalin sulphate, from which meycalin can be separated by making alkaline, shaking out with chloroform and recrystallizing. Anhalondidin is separated and purified with difficulty, but can be

obtained by formation of the platinum salt which is difficultly soluble in water, or by treatment of the hydrochlorides with alcohol. The hydrochloride of anhalonin is precipitated when a solution, in absolute alcohol, of the alkaloids insoluble in ether is neutralized with HCl. This principle is said to be strongly poisonous and produces effects similar to those of strychnine. Lophophorin remains in the mother liquor of the hydrochlorides of the alkaloids insoluble in ether, from which it may be separated. It has not been obtained in pure condition, but only in the form of a colorless syrup.

PHYSIOLOGICAL TESTS.

USING THE ABOVE CONCENTRATED EXTRACTIVE MADE BY OURSELVES.

The object of the investigation being only to determine the toxicity of the drug and to locate its relationship to other known poisons, it was only necessary to make a few experiments upon the lower animals, such as frogs and guinea pigs.

A solution was made of the concentrated extract representing the mixed poisonous products of the drug of the strength of 8 mm. to the cc. This solution was sent over to the Pharmacological Laboratory to Doctor S. A. Mathews, with a request for a report upon the toxicity of the substances, and, if possible, to get a report upon its relation, if any, to other known poisons. Doctor Mathews reports that one-fourth of a cubic centimeter, representing 2 mm. of this extractive, put a frog into tetanus spasms almost immediately, and the action upon the frog was practically identical with that of strychnine.

One of the principles which has been isolated from this drug and the structural formula for it are as follows:

$$\text{Mescaline:}\quad C_6H_2 \begin{array}{ll} CH_2(NH)(CH_3) & 1 \\ OCH_3 & 3 \\ OCH_3 & 4 \\ OCH_3 & 5 \end{array}$$

Our object will be, in the future, to obtain a large quantity of the buttons and endeavor to separate its various constituents.

PRUNELLA VULGARIS.

By L. E. Sayre.

ONE of the members of the Academy, Miss Grace Meeker, called the writer's attention to the remedial qualities of *Prunella* in cases of poison ivy, and suggested that an analysis of the plant be made in order to determine wherein lay its remedial quality.

Before referring to the analysis, it may be well to call attention to the nature of the *Rhus* poisonous principle, which is extremely active, even in minute quantities, as it forms a part of the resinous portion of the plant and which is very difficult to remove from the skin or clothing. Washing with soap and water is not sufficient to cause its removal. If the skin is thoroughly cleansed with soap and water until it is to all appearances clean, the poison still remains. A mixture of powdered soap pumice and sodium carbonate gives better results, although this does not insure safety.

The best agent for removing the poison itself is a mixture of two parts of ether and one of alcohol, and this should be carefully applied, first with a pledget of absorbent cotton saturated with the ethereal mixture, and then the moistened surface immediately dried and scraped with another pledget of clean absorbent cotton, and both pieces of cotton so used thrown away. This process of the application of the ethereal solution and wiping with dry cotton is repeated several times until the visible resin is entirely removed. This is the only sure mechanical means of absolutely curing the toxic principle of this active drug.

There has been some contention that there is a volatile principle, as well as a fixed resinous oil associated with the principle. Very susceptible persons have been poisoned from the exhalations of the plant. A remarkable case of this kind has been published in the *American Journal of Pharmacy* for 1914, page 112, contributed by C. E. Bessey. Quoting from his article, he says: "From my personal experience," which he gives in detail, "I do not see how any one can escape the conclusion that the poison of ivy is volatile." By merely looking at the plant, without handling, he himself received the effects

of the poison. The circumstances were as follows: The plants were taken from a vasculum among which was the *Rhus* (all handled by an assistant). His face became severely poisoned. As the box was opened he leaned over and looked in, being careful not to come in contact with either the box or the plants. His record of his experience seems to indicate that his conclusion of the volatility of a part of the poison is well founded.

As to the value of *Prunella*, it would seem, from our observation and investigation, that its remedial value lies very largely in its soothing qualities. We are not without many of such plants growing in the state of Kansas, as, for example, the *Grindelia*. This plant, which is so common to our western plains, gives rapid relief in ivy poison by the application of cloths dipped in a mixture of the fluid extract and water. *Grindelia robusta* and *Grindelia squarrosa* (gum plant, tar weed) both contain principles which have the effect of allaying local irritation of various kinds. It allays, for example, pain in the affection of herpes zoster (shingles), burns and blisters. It makes a good application for chafed and irritating surfaces without imparting any other complications in the way of irritation. The principles residing in these are tannic acid, together with certain mucilagenous and oleoresinous principles not well defined.

Analysis of Prunella vulgaris.

		Per cent.
1.	Moisture	7.83
2.	Chloroform extract	6.55
3.	Alcohol extract (80 per cent)	13.35
4.	Soluble in water	11.04
5.	Soluble in dilute acid	14.64
6.	Soluble in dilute alkali	22.23
7.	Cellulose	25.07
8.	Residual ash	7.07
	Total	107.78
9.	Total ash	14.54
10.	Nitrogen:	
	a. As N_2	1.69
	b. As albuminous material	10.69

CULTIVATION OF MEDICINAL PLANTS IN THE UNITED STATES

To Meet the Emergency Caused by the European Conflict.

By L. E. Sayre.

THE present European conditions have emphasized the necessity of the cultivation of medicinal plants in the United States. Hitherto we have been almost wholly dependent upon European countries for most of the medicinal plants, valuable preparations of which are manufactured here. The attention of the American people has frequently been called to the need of the development of the cultivation of crude drugs on American soil, but thus far very few have heeded the advice of pharmacists in this direction. Some years ago, in California, several comparatively large sections of land were set aside for the growing of the more important narcotic solanaceous leaves, such as belladonna, hyoscyamus and stramonium. This enterprise was started by a large manufacturing firm of New York City. Since that time the work has been carried on by Prof. Albert Schneider, of San Francisco. Some of the products of this farm have been sent to the pharmaceutical laboratory of the University of Kansas for analysis. The results of these analyses have shown that the plants raised on the Pacific coast are equal, if not superior, in alkaloidal constituent to those of the European cultivation.

When we consider the many tons of these plants consumed in the United States in making preparations such as tinctures, fluid extracts and medicated plasters, it becomes evident that the supply, if furnished by our own country, would not only be a profitable undertaking, but would put us in an independent position. The dependence upon Europe is brought forcibly to our attention by the statement that the supply of many of these drugs will soon be exhausted. Unless some change occurs in European affairs, the United States will be forced to provide substitutes for these well-known and tried agents.

It would seem that most any rich soil would yield abundance of our common stramonium, or jimson weed. On account of its commonness, it is called the barnyard weed. Every one who knows anything about medicinal plants knows that this

plant grows luxuriantly in Kansas, as it is recognized on most of our common roadsides. Since stramonium furnishes the narcotic alkaloids closely allied to hyoscine and atropine, there is no reason why this plant should not be utilized to a greater extent than it is, and some enterprising firm should bring about its commercialism and utilization as alkaloidal products. Now is the psychological moment, so to speak, to bring about this desired end—to show that the United States is a place and has a soil suitable for the raising of some of our vegetable medicinal substances.

We may cite some interesting cases of profitable medicinal plant culture. In certain sections of the country near Lebanon, Pa., among the people who are known as the Shakers, there has been for years the cultivation of such plants as conium, lobelia, and many of the drugs used in the eclectic practice. In Michigan, in the low, marshy and boggy part of the country, hundreds of acres are under cultivation in raising the plants of the natural order of Labiatæ. The writer visited one of these farms last summer; in fact, has visited the same one for a number of summers. It contains 1400 acres of land entirely devoted to the cultivation of peppermint and spearmint. This farm is located near Fenville, Mich., and another one, of 2100 acres, is located near Kalamazoo, Mich. These two farms produce thousands of pounds of peppermint and have grown into a stupendous industry, employing hundreds of men during the summer and a very large number during the winter months, when the farm has to be taken care of and repairs made to the machinery used for the distillation of the plant in order to obtain the volatile oil.

One of the most expensive, and possibly one of the most profitable, plant industries that could be promoted in the United States is the cultivation of goldenseal (*Hydrastic canadensis*). This drug brings on the market $4.75 per pound; pressed leaves, $7.35 per pound. The cultivation of the plant at the present time has not gone far beyond the experimental stage. Fifteen or twenty years ago the supply of the wild plants was sufficient to maintain the consumption, but during the last ten years the demand has been so great as to almost exhaust our fields and forests where the plant finds a natural habitat. It is interesting to know that some have cultivated the *Hydrastis* successfully. John O. Baldwin contributes an

article in the *American Journal of Pharmacy* for April, 1913, and we take the liberty of extracting from his article such portions as will be of interest and applicable in this paper. He says:

"The natural home of the goldenseal is in the deep shady nooks of our American forests, where the soil is rich and soft and deep, and the moisture and the drainage are in its favor. Where once it grew in profusion, it is found only in patches now, and these small areas are constantly giving away to only here and there a single plant, and these lingering halos of the past wild woodland glory are year by year teaching their lesson of conservation to the student and grower.

"To be successful in the growing of this plant, the natural conditions must be carefully and strictly observed, artificial means being employed only where they improve upon the natural, where the plants originally grew, and then the natural conditions should not be eliminated or overlooked."

Echinacea angustifolia is a plant natural to the soil of Kansas. It is well known that this plant has acquired a great reputation in certain forms of disease, and as an antiseptic local application and as an internal remedial agent it is growing in popularity, so that thousands of pounds of the root have been shipped out of the state, consumed in medicinal preparations which find ready demand by the medical profession.

Ginseng is a plant which has received some attention. In some parts of Ohio the plant has been cultivated successfully. The writer visited some patches of ground where this plant was cultivated near Toledo, Ohio. Here and there over the country are persons who are experimenting upon its cultivation. The soil and condition of its cultivation are very similar to that of *Hydrastis,* above referred to.

Many other plants might be named in this connection, but it would prolong this article unduly, as this is written simply to call attention to the subject and to excite interest of the agriculturist and gardener. Those who are interested, or will become interested in this plant cultivation, as above suggested, would do well to correspond with the Bureau of Plant Industry of Washington, D. C., where they can get in communication with the department which has had this matter under careful scientific study for a number of years.

The sudden cessation of foreign chemical manufacture and importation from European countries, notably Germany, has caused considerable discomfiture in the American chemical and pharmaceutical circles and has induced the authorities of

the University of Kansas to make a strong plea to the legislature for the establishment of a greenhouse suitable for the raising of medicinal plants, and it is hoped that through the Pharmacy Department this cultivation and experimentation will eventually aid in the production of these, and at the same time enhance the value of the farms and garden spots of Kansas.

IV.

MISCELLANEOUS PAPERS.

1. "One of the First Millstones."
   By A. A. Graham.
2. "America's Opportunity in Science."
   By George W. Tidd.
3. "Malignant Tumors."
   By J. M. McWhare.
4. "A Convenient Card Catalogue of Food Adulterants."
   By E. H. S. Bailey.
5. "Some Experiments With the Mason Fruit Jar."
   By Agnes Anderson Murray.

ONE OF THE FIRST MILLSTONES.

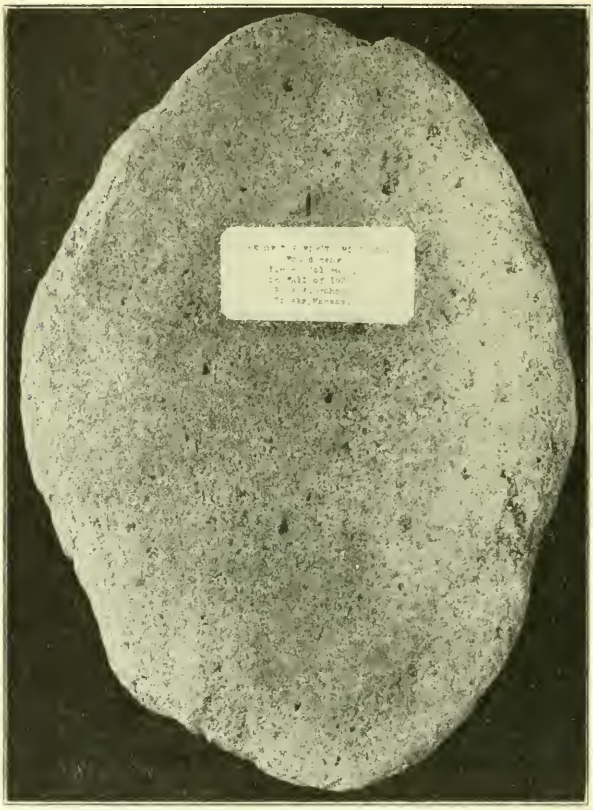
By A. A. Graham.

IN 1903 I found on the plains near Limon, Colo., a granite millstone, if not of prehistoric times, at least of aboriginal origin. While that part of Colorado is covered with small fragments of disintegrated granite, showing the surface to be denudation from the Rockies, no mases of granite are found short of the mountains nearly a hundred miles farther west. The shape and wear of this stone, however, are distinctive enough to tell the tale, even though picked up among the Rockies themselves.

A practical man, figuring on a showing and profits, would want to know the plan, the kind and capacity of the mill. The answer is, a granite stone weighing 12 pounds, elliptical in outline, longitudinal diameter 14 inches, transverse 10 inches, average thickness 1½ inches, oval on the under side, and dished and smooth from the edge to ¾ inch in depth at the center on top. A portion only of the bottom was worn smooth.

An anthropologist looking at this stone would say that here is one of the prehistoric or aboriginal grinding stones of primitive man. In this hollow, grain was placed and crushed by another stone of about the size of the first, held in the hand of the grinder, and rubbed or vibrated backward and forward. This accounts for the smoothly worn hollow surface. Turning the stone over, the rude chipping of the under portion to form the oval shape takes us back to the chipped-stone age. The smoothly worn portion of the bottom, not being centrally located, was not made smooth by contact with the earth or a base, when in use, but was made smooth by another use of the stone: when the grain was ground in the hollow, the meal was then mixed with water and kneaded into dough. This was then removed from the trough, the stone turned over, and small portions or balls of the dough patted into flat cakes on this smooth portion of the bottom, for baking on hot stones or by being held over coals of fire.

We thus see the baker's implements and art arising in relation with, and as a part of, that of the miller. The dished form and elliptical outline of this stone enable us to trace the



A prehistoric millstone.

original of the platter, and give us an insight into the origin of dishes and pottery as well as the development of stone vessels, while the material, the use, and the position when in use, bring us back to ourselves—the nether millstone of granite differing as to the result only in that the buhr is now revolved by mechanical means as against the former fair hands of "women grinding at the mill."

The edge of the stone bears several marks of violence, but consideration of these might only lead us into speculations and musings.

This stone is now in the Kansas Academy of Sciences at Topeka.

AMERICA'S OPPORTUNITY IN SCIENCE.

By George W. Tidd.

WHILE the planet is shattered by the turmoil of a world war, it is well for us to take an account of the position that our country occupies in scientific achievement. There never was a time when things needed to be better done than now. To get the proper perspective is our need. We are most apt to view things as they relate immediately to our affairs. The proper relation to be sought is that of a world civilization. The war drum is heard in the centers of European scientific culture. Their laboratories are deserted by the workers for the battle front. Test tubes and culture media have been left for the bayonet thrust and carnage of battle. The hand skilled in the accuracy of measurements in the research laboratory now uses the entrenching spade, and the eye trained in spectrum determinations now sights the deadly rifle at brother scientists. Some have fallen, others languish in prison, to return at the close of the war to resume their scientific labors with weakened physical powers and faculties blunted by the scenes and terrors of battle. Never again can they have that mastery of their powers demanded by research. The bitterness of race hatred and the enmity of international strife rankle in the breasts where once flourished the spirit of scientific comraderie and coöperation. Billions of dollars are being wasted in war's destructiveness, leaving nought for the needs of scientific work.

Shall we allow the onward progress of world development to cease, or, as the leading industrial nation, assume the obligation of doing the world's intellectual and scientific work. This is America's opportunity. The horror of the European conflict is spreading a pall over the whole civilized world. A stagnation is felt in our industrial and business affairs which is gradually spreading into the intellectual pursuits. Let us arise and shake off this torpor. It will require a generation for Europe to recover from its titanic struggle. Shall we hesitate and allow the progress of civilization to be retarded for that period?

Hitherto America has been a third-rate power in scientific

achievement; its opportunity is now at hand to rise to the first rank. Let us not stand appalled at the European conflict, but enter at once with greater effort in the scientific work that our hands find to do. This country needs more trained investigators, but especially it needs better facilities for their work. The call came recently for help for the starving Belgians, and America quickly responded with $10,000,000. Let the call be earnestly made for the funds that are sorely needed for the development of scientific work and it will surely be heard and adequately answered. While our government is seriously considering the advisability of additional expenditures for national defense, its attention should be called to the urgency of our scientific needs. It is said that more men are needed in our army and navy and that they should be drilled for service. A greater need is for more brilliant young men to be thoroughly trained for scientific pursuits. Throughout the length and breadth of our land a greater effort should be made to enlist able young men and women in scientific work. Not only should we encourage our own, but we should give a hearty welcome to scientific workers of other lands who, discontented with conditions there, may become interested in locating here.

The effort that is now being made by the American Association for the Advancement of Science in the greater development of research should meet with widespread approval and aid. From the very nature of their work, scientific bodies must necessarily be exclusive in character. This leads to a weakness in the lack of coöperation and understanding between these bodies and the general public. The latter is entitled to know what is being undertaken and what is being accomplished by scientists if it is expected to contribute to the support of their efforts. The general public is unable to read the reports of their work in the scientific journals. Its source of information must be the daily papers, the popular magazines, and popular lectures. Too often the articles of the popular press fail to properly present the results of scientific investigations. It is clearly the duty of scientists to reduce their results to language comprehensible by the general public and give their reports through the popular press. The writer has tried the plan of writing articles on scientific subjects in a popular form for the daily press, and has always been pleased with the demand for them.

The popular scientific lecture seems, unfortunately, to be on the decline. Too often they are given by men who are doing it for the financial rather than the scientific consideration. Scientific workers may do much to aid in the popular dissemination of scientific knowledge by giving some of their time to popular scientific lectures for the general public. The attention of public-school and college students should be frequently called to current scientific work. For years we have allowed able young men and women to be deterred from entering upon scientific research on account of lacking financial support needed to maintain them comfortably while engaged in the work. We have passed our pioneer days, and this condition does not longer need to exist. National, state and local aid should be evoked for this purpose. We have been very proud of the Carnegie Institution and the Rockefeller Institute for Scientific Research, and justly so; but far better than pausing to express our gratification at the founding of these splendid institutions and in exultation at the work they have already done, would have been to secure the founding of other similar institutions.

There is a real danger in overemphasis of the so-called practical in education, if that may be made to detract from research. The scientific work in various lines contributes to the success of other lines of investigation, so that the public should be made to know that all lines of research must be fostered. Public aid may be more readily obtained if the solution of its problems is more eagerly undertaken by scientists. A research made on the properties of the soil may lack somewhat the fascination of the pursuit of electrons, but it gives splendid opportunity for the young research worker to gain experience, and urgently needs to be done if we have and hold the full coöperation of the public. A closer relationship between the state governments and the research laboratories within their borders is important. Problems arise in the development of any section of the country that can be adequately dealt with only by the research worker. When these workers show their willingness to devote their time to such problems, and when the public realizes that results may be had from such coöperation, abundant funds will readily be furnished for the needs of research.

A pronounced decadence has taken place in the high-school sciences in the period from 1890 to 1910, inclusive, according to the report of the Commissioner of Education, 1910, vol. 2,

p. 1139. We can not hope to maintain an adequate body of scientific workers unless the study of the sciences in our public schools regains its former prestige. Scientific bodies must give due consideration to this condition and aid the educators in its improvement, or there will be too small a number of young men and women fitted to supply the ranks of the research workers in the next generation. There are a number of ways in which science may be popularized. Through the medium of scientific books written in a simple, popular style many may be reached through city libraries and in the home. Specialists should select such matter from their investigations that will possess interest for the general public and issue it in an attractive form. We must face this problem fairly. Either we must have a well-trained, thoroughly interested and alert body of young men and women from which to recruit the next generation of scientists or America must sink to a still lower rank in scientific achievement. If they live up to their responsibility at the present time it must be the policy of American scientists to press home the urgent needs upon the public mind in order that we shall step into our rightful place, the first in scientific rank, and shall carry forward the great work of civilization.

Must our college and research laboratories be longer dominated by the "Made in Germany" label? American scientists should at this time encourage home manufacture of scientific goods. If they lend their aid and advice in designing apparatus, and if our manufacturers spare no expense in the employment of the highest skilled mechanicians that the world affords, it will only be a few years until the American label will be a sufficient guaranty of the highest efficiency in scientific goods.

MALIGNANT TUMORS—CANCER.

By J. M. McWharf.

IN 1909 we presented to the Academy of Science a paper on the subject of cancer. An effort was made to give in detail all the facts known to the medical world concerning this much-dreaded and fast-increasing disease. After five years of careful study by eminent men in the profession, scientists, we are yet unable to say to the world that we have conquered the disease and here is the panacea. In our study of cancer we turn to accessible literature and the latest teaching of pathology pertaining to the growth of neoplasms in their various forms, clinical and microscopical. Histology of malignant disease is almost nil. From statistical reference we know that cancer is more prevalent in some districts than in others. That it is common in some trades or vocations and quite uncommon in others.

Considering the question from this viewpoint, we are forced to conclude that there must be some element in the environment of the individual that brings on the disease. Mechanical irritation is said to be a factor in the production of cancer, but the theory is not a satisfactory one; we can not always determine. We can not see what mechanical irritation can produce a sarcoma of the uterus and many other maglignant diseases. I therefore conclude that it is parasitic disease. We have a warty disease in potatoes due to a minute fungoid organism, which in character is essential to the cells of malignant tumors. Biologists call them Mycetozoa or Myxomycetes. If this disease has full sway the potato is formed into a wrinkled mass that soon decays or drys up.

A writer asserts that irritation and hypertrophy of cells may be caused by parasites which never bring their protoplasm into direct contact with that of their host, and may stimulate it through both cell walls to an abnormal growth. These cells grow larger and divide more frequently than the normal, the sap changes color to red, while the numerous compound crystals normally found in the tissues diminish in number and are different in shape, large quantities of starch are stored up, and even the vascular bundles are altered in character.

These changes indicate a profound alteration in the physiological work of the protoplasm of the cells of the host, and yet the fungoid germ has done its work through its own cell walls and those of the host. If these organisms have the power to produce abnormal growth in vegetable cells, can we not theoretically say that the unlimited cell formation in cancer is thus produced. A wide difference exists between vegetable and animal cells, but the fact remains that fungoid pests of plants are communicated to and produce the death of insects. These organisms are found upon the border line between plants and animals.

Will not a more thorough investigation of the life history of certain organisms that are to be found on the border line clear up much that seems obscure in regard to the cancer? Weronin, in 1878, asserted that malignant growths in man might eventually prove to be due to a parasite of a similar nature. Careful study of the morphology and biology of the various fungi will more forcibly impress us with the belief that cancer is of parasitic origin, and if this theory is accepted we are to conclude that it must be due to an organism belonging to some of the various fungi which induce malignant growths in plants; that in certain cases the cells of the host become its own parasite.

Starting with this hypothesis—that cancer is due to a parasite not unlike the Myxomycetes—it would be exceedingly gratifying if our knowledge regarding the physiology and metabolism of such organisms were more perfectly understood. Unfortunately, there has been very little investigation along this line. This neglect is due, doubtless, to the fact that zoölogists are not agreed upon the question as to their place of consignment; that is, are they plant or animal? Our knowledge of the entire group of organisms known as Myxomycetes is so obscure at this writing that we are unable to arrive at a fairly good conclusion as to the part they play in the production of disease. Time and close application to the study of the subclasses will alone reveal much needed light. *Plasmodiophora brassicæ* is a parasite that has cost the agriculturists much from a financial standpoint. They have learned, however, when manures have been subjected to the action of sulphuric acid this parasite is almost sure to appear in the plant. Doctor Ward, an eminent authority, says finger-and-

toe disease of plants is due to *Plasmodiophora*; that the disease is nearly or quite unknown if the soil contains a high percentage of lime. If sulphuric acid plays a part in the production of cancer, and the cancer organism is akin to the Myxomycetes, then lime would play a large part not only in prevention but the cure.

We will cite a few of the many occupations that could be brought forward to prove the theory that sulphuric and sulphurous acids enter largely as a factor in the production of cancer. The chimney sweep in his vocation shows the highest ratio, and is placed at the head. He comes in contact with a soot that contains ammonia and sulphurous acid. They are products of combustion. Coal soot, when it comes in contact with a plant, injures its growth, but pure carbon soot derived from benzine produces no deleterious effects upon them. Stockhardt demonstrated this fact. The brewer uses a bisulphide of lime as an antiseptic. It is prepared by saturating a solution of sulphite of lime with sulphurous acid. The tin-plate manufacturers immerse the blocks of iron in sulphuric acid before the tin is applied. The X-ray cancer is produced by the hyposulphides acting upon a weakened skin resistance. We feel that time will not permit the introduction of a larger number of illustrations. The above vocations give a large mortality rate for cancer. We assert here that a careful study by scientific investigation has proven the truth of the assertion that a very much larger number of cancer cases are shown in all the vocations where sulphuric and sulphurous acids are used.

We study the ideal human body as a symmetrical product; each part is developed in perfect harmony. Frequently independent growths are formed upon the body. They are groups of rebellious cells which have started upon an independent existence. These cells may be harmless, and frequently are; hence of no importance. They may be malignant and destroy life. Tumors are classified in a general way as benign and malignant. A benign tumor reaches a certain stage of growth and ceases to act. A malignant tumor has the power of unlimited growth. Cancer once started is a destroyer of tissue and of life. A benign tumor may develop new vitality and become malignant. Can we not say, then, that all tumors are in a sense related? Cancer does not always confine itself to the point of starting. Cells break loose from this point and

are carried by the blood to other parts of the body, where they lodge and start new foci of the disease. In our study of this subject many suggestive questions confront us. We know that the oxygen of the blood enters the cells by diffusion; that a greater amount is consumed in early than advanced life. The cells of advanced life, having a less supply of oxygen, are more amenable to malignant disease. A lack of free oxygen suggests a predisposition to cancer. It is found that a malignant disease produces an increased rate of the pulse. We are here notified of a fact, viz., that the tissues are in need of more oxygen for the blood.

Small lung capacity, with a small pulmonary artery, predisposes to cancer. It has been shown that blood taken from a cancer patient contains a greatly reduced amount of hæmoglobin. One thousand grammes of normal blood contains 125 grammes of hæmoglobin. In cancer there is frequently but 25 grammes. Such evidence is usually manifest early in the disease.

Green, in his work on cancer, gives coal combustion in grates and chimneys as one of the exciting causes. He states that a product of that combustion is sulphurous acid, sulphur dioxide and sulphur trioxide; that these gases are heavier than air and are frequently recognized as being present in the room; that soot and coal tar is usually found in abundance in the chimney, and that the air of the room is impregnated from the soot and the sulph-acids. Green further states that, almost without exception, houses in which cancer has occurred have badly drawing chimneys, and he gives it as his belief that this is one of the keys to the problem.

Now, if sulphuric and sulphurous acids are important factors—and we believe that they are—in the production of cancer, then as a preventive we should, where possible, avoid contact with any and all materials that contain them. When the disease is once established, and we hold that it is due to an organism not unlike the Myxomycetes, the question of prescribing calcium is of supreme importance.

Starting with the theory that we have and are combating a parasitic disease, we are forced to take cognizance of the fact that this fungoid organism can flourish only in its optimum temperature. The temperature of a parasitic fungi should approximate that of the body of the host. Otherwise it will not germinate. The normal temperatures of animals vary.

We would therefore have a comparative immunity existing between them. Actual demonstration has proven that a very large percentage of the small fungi are destroyed by a temperature of 50° C. The ray fungus will not germinate at 50° C. Raise it to 70° C. and retain this heat for ten minutes, we destroy the germ. We would suggest as a treatment for cancer, then, the internal administration of calcium, coupled with the application of heat for a period of at least ten minutes at 70° C.

Lime water taken internally has proven of benefit in the cure of warts and other tumors. May we not expect benefit from its use in the treatment of malignant tumors?

Doctor Hood cites a case where a large carcinoma was cured by the internal administration of pulverized oyster shells after they had been baked. Some twenty grains were given two or three times a day. A word in regard to the much-lauded remedy, radium. If it possesses any merit it would be only in the early or primary treatment. Failure seems to be its cognomen. It will soon be forgotten. Ignorance of the nature and pathogenesis of cancer leaves us with a difficult problem upon our hands.

Treatment of the various forms of malignant growths and their curative effects is a much-mooted question. Many and varied internal remedies have been used with no flattering success. Radium, X-ray, Finsen light, and cold cautery, each has supporters, but the facts are that not one has absolutely prevented the neighboring glands from taking on the same growth. To-day we find the medical profession turning towards internal medication. The desire is to secure some chemical substance which, when administered by the mouth, will produce the desired result. If a chemical is found that when given internally will destroy the cancer cell, we will have produced the cure. I look with great favor upon this line of procedure.

While the disease is local, benefit may be derived from the use of the various caustics, as chloride of zinc, caustic potash or soda, acid nitrate of mercury, lactic acid, etc. Not one of these, however, is as reliable as the knife. To-day the important rule is: Remove early the growth fully and completely by the knife.

CONCLUSION.

1. From all data received, we conclude that cancer is a parasitic disease.
2. That sulphuric and sulphurous acids are exciting causes.
3. That heat 70° C. externally, coupled with internal administration of calcium, is at least a rational treatment.
4. We have no known specific.
5. That it is a local disease at first.
6. That it may be communicated from one person to another.
7. That a resort to the knife early in the disease (while it has a local focus) is by far the best and safest treatment.

A CONVENIENT CARD-CATALOGUE OF FOOD ADULTERANTS.

By E. H. S. Bailey.

THE federal and state laws which have been enacted during the past eight or nine years against the adulteration and misbranding of foods make it necessary that standards for pure foods should be in the hands of chemists and others who have to do with the enforcement of these laws. Since these laws have been in operation chemists in food laboratories have been busily employed studying the individual foods and detecting the common adulterants found in them, while at the same time it is unfortunately true that some food manufacturers have used much ingenuity to evade as nearly as possible the rulings of the departments.

After several years of experience, however, with a given food product, the common adulterants to which it is subject become quite well known, so that it is only occasionally that a new fraud upon the consuming public is discovered.

Food may be injured or decreased in value in various ways. It does not often contain substances that are actually and actively poisonous, but it may contain ingredients which decrease its food values. It may have been treated by some process which has decreased its value, as when rice is "polished" and coated to make it have a better appearance, notwithstanding considerable valuable nutritive material is by this process removed. The food may have been subjected to some adulteration which makes it "appear better than it really is," as when distilled vinegar, which is inexpensive, is colored with caramel and sold as cider vinegar, a variety which costs more money; or when Hamburger steak, that has been allowed to stand so long in the shop that it begins to show its age, is treated with sodium sulphite to give it again the color and odor of fresh meat.

Foods are also injured and rendered unfit for consumption by improper methods of preparation or handling, as when oranges are picked while still immature, and sweated to bring out the color and give them the appearance of ripeness; or when eggs which have been kept for many months in cold

storage are sold for "strictly fresh country eggs." Again, foods are often misbranded as to the place where grown or produced. A cheese may be labeled as imported from France or Switzerland, when in reality it was made in Wisconsin or New York; a sweet corn may be put on the market purporting to be raised in Maine, when it is really the product of a Missouri cannery.

The net weight of all foods sold in packages must be stated on the box or carton although manufacturers and dealers are allowed until next summer to dispose of the unmarked goods which they may have on hand. Most food manufacturers have already complied with this federal law, and very few packages not bearing the net-weight label are found on the market.

With all these chances applicable for adulteration, misbranding and causing a lowering of the grade of foods, it might seem that it would be difficult to classify or catalogue them; but the fact is that the whole story can be told in about 100 ordinary library cards. The general classes of foods, such as beverages, cereals, eggs, fruit, fish, meat, milk products, nuts, oils, starches, spices, sugars and vegetable products, are indicated on the guide cards, and under each head the individual foods are noted, with the common adulterants or means of falsification serially numbered. Thus under "Oysters" occur the following:

1. Shipping with ice in tubs (floating).
2. Growing where there is danger of typhoid infection, etc.
3. Selling under a wrong name as to locality where grown.
4. Coloring green with salts of copper (English).
5. Use of preservatives, such as formaldehyde, borax or boric acid.

This system has the advantage that it is very compact and can be expanded by the addition of other numbers showing adulterations or falsifications on each card, as they are from time to time noticed; also other foods can at any time be introduced into the list. It is believed that this method of classification will prove useful to any teacher or in any laboratory where the purity of foods is made an object of study.

SOME EXPERIMENTS WITH THE MASON FRUIT JAR.

By Agnes Anderson Murray.

IN the following brief discussion of the Mason fruit jar I have brought together some data that have been obtained not only in the Kansas food laboratory, but also in the Indiana state food laboratory.

We will take up first the question of volume. For years the housewife has considered Mason fruit jars as standards of volume. She has sent quart jars to the grocery store for vinegar, molasses and milk, thinking that in this way she was outwitting the wily, short-measuring grocer and obtaining a true quart. But investigation of the volume discloses the fact that the quart size is almost a half pint short measure, and the larger sizes short in proportion. It is impossible to estimate the total loss to the consumer that his uniform short volume of Mason jars has caused.

The original cover of the Mason jar was a zinc cap which screwed on, and which when used in connection with a rubber ring gave an air-tight seal.

It was found that this zinc cap was acted upon by the contents of the jar, and in many cases holes were eaten through the cap, the metal going into solution. We have at the University some jars covered with such zinc caps, which at one time contained vinegar. The caps are badly corroded and contain many holes. Analysis of the contents showed a high zinc content. An improvement over the plain zinc cap was one made with a glass or porcelain lining, and this is the type most commonly found on the market to-day. In this type only a small amount of metal comes in contact with the liquid. A later type is so arranged that the closure is made by placing the rubber ring on the edge of the glass neck in such a way that the closure is made not with the edge of the cap, but by the inside glass lining. This type is the White Crown.

Experiments were carried on at the Indiana station to determine the relative merits of the old and new caps. Seven jars were filled, in duplicate, with acid solutions of the following strengths: ½ and 1 per cent phosphoric acid, ½ and 1 per cent acetic acid, ½ per cent tartaric acid, and ½ and 1 per cent nitric

acid. The jars were inverted and allowed to stand six months. At the end of that period the following things were noted: condition of the cap, loss in volume, condition of solution, whether clear or turbid, and the presence of zinc. The following results were obtained:

I. On five out of seven jars the White Crown caps were in perfect condition. The outer rims of two caps were slightly corroded. All of the Mason caps were corroded.

II. There was no loss in volume in the jars sealed with White Crown caps. In five of the seven jars sealed with Mason caps there was a loss in volume. Two jars had completely evaporated, one had evaporated one-half, another three-fourths, and the fifth had a slight loss.

III. The solution in each of the jars sealed with White Crown caps was clear, while in two of the jars sealed with Mason caps the solution was decidedly turbid.

IV. Zinc was absent in each of the solutions in the jars sealed with White Crown caps and present in each of the solutions sealed with Mason caps.

The general conclusions are that the White Crown cap is superior to the Mason cap:

1. It does not permit the contents to come in contact with any metal.

2. It is more sanitary in that it is more easily cleaned. The whole surface is smooth.

3. It permits a tighter seal.

V.

APPENDIX.

1. Necrology.—Frank Olin Marvin.
   By E. H. S. Bailey.
2. Library and Museum Report.
3. Publications.
4. Index.

FRANK OLIN MARVIN.

By E. H. S. Bailey.

PROFESSOR MARVIN, who was a member of the Kansas Academy of Science since 1884, was born in Alfred Center, N. Y., May 27, 1852, and died in San Diego, Cal., on February 6, 1915. He was the son of Rev. James Marvin, a minister of the Methodist Church and for some years professor of mathematics in Alleghany College, and later chancellor of the University of Kansas. Professor Marvin graduated at Alleghany

Frank Olin Marvin.

College in 1871. He spent some years in the field as a civil engineer, and in 1875 was appointed instructor in mathematics and physics in the University of Kansas. In 1883 he was appointed professor of civil engineering, and when the School of Engineering was established, in 1891, he was appointed as the first dean.

During all the time that Dean Marvin was connected with the University he was untiring in building up the scientific departments, and particularly the School of Engineering. In 1912 impaired health compelled him to retire from active work, although he was retained on the faculty as advisory dean. The Carnegie Foundation granted him a retiring allowance in the summer of 1914.

To show something of his educational work, it may be noted that he was active in the organization of the Society for the Promotion of Engineering Education, and in 1891 was elected as the president of that organization. He was a fellow of the A. A. A. S., and one of the vice presidents in 1896; a member of the Civil Engineering Society and the Society for Testing Materials, president of the Society of the Sigma Xi and engineer for the Kansas State Board of Health. At the same time he was contributing numerous articles to scientific publications.

As a member of the Kansas Academy of Science, Dean Marvin was elected treasurer in 1891, vice president in 1892, and president in 1906. His address as retiring president of the Academy was an exhaustive study of "The Recent Growth of Engineering Colleges." He showed his faith in the future of engineering schools in one of the closing paragraphs of this address when he said: "The speaker further believes that applied-science colleges are but beginning their career of usefulness, not only as places for the higher education of youth, but as centers of applied science, where investigations of utilitarian questions go on side by side with those of pure science—not simply side by side, rather hand in hand; for no new truth of science is discovered but that sooner or later it is found to have its practical application somehow or somewhere." In the Transactions of the Academy will be found numerous papers by Dean Marvin on such topics as "Magnetic Declination in Kansas," "The Second Setting of Cement," "Precision of the Solar Attachment to the Engineer's Transit," "Water Supply from a Sanitary Standpoint," "Tests on the Strength of Building Materials," and "Notes on Some Kansas Paving Brick."

In private life Professor Marvin was quiet and undemonstrative. He had an artist's eye for beauty in form and color and a musician's ear for harmony of sounds. He had accumulated a rare collection of etchings, and for many years played the organ in one of the churches of Lawrence. Although to the casual acquaintance he might have seemed cold, the student in trouble over his work soon found that he had in Dean Marvin a most sympathetic friend. He devoted his life to teaching engineering, and his success is shown by the faithful and conscientious work of the hundreds of young men

who are out in the world to-day winning a place for themselves.

The new engineering building at the University of Kansas is called "Marvin Hall," and in this building the former students and friends of Professor Marvin have installed a bronze portrait bust to commemorate his name.

LIBRARY AND MUSEUM REPORT.

The library of the Academy is now associated with that of the Historical Society as a separate department, and will be placed in the book stacks and be indexed and catalogued by the best modern and approved methods. It has been the policy of the Academy in late years to apply the funds arising from membership dues to building up this library, especially by purchase of books of great value and not likely to be found in other state collections. The library is constantly growing through its domestic and foreign exchange list, and now contains more than 7000 volumes, including those now waiting to be bound by the state printer. The combined libraries in the New Memorial Building will number more than 100,000 volumes, and with the state library will furnish by far the largest book collection in Kansas. Our museum has been greatly enriched by a gift to the Academy of the state mineral display erected at the St. Louis Exposition, and given suitable cases to hold this large amount of material. It thus has the finest economic collection of the Kansas mineral industries in the state—an exhibit which received two gold medals, twenty-two silver medals, and fourteen bronze medals. We fondly cherish the hope that this museum may continue to grow till it furnishes to Kansas advantages similar to those given to Pennsylvania by the Commercial Museum of Philadelphia.

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